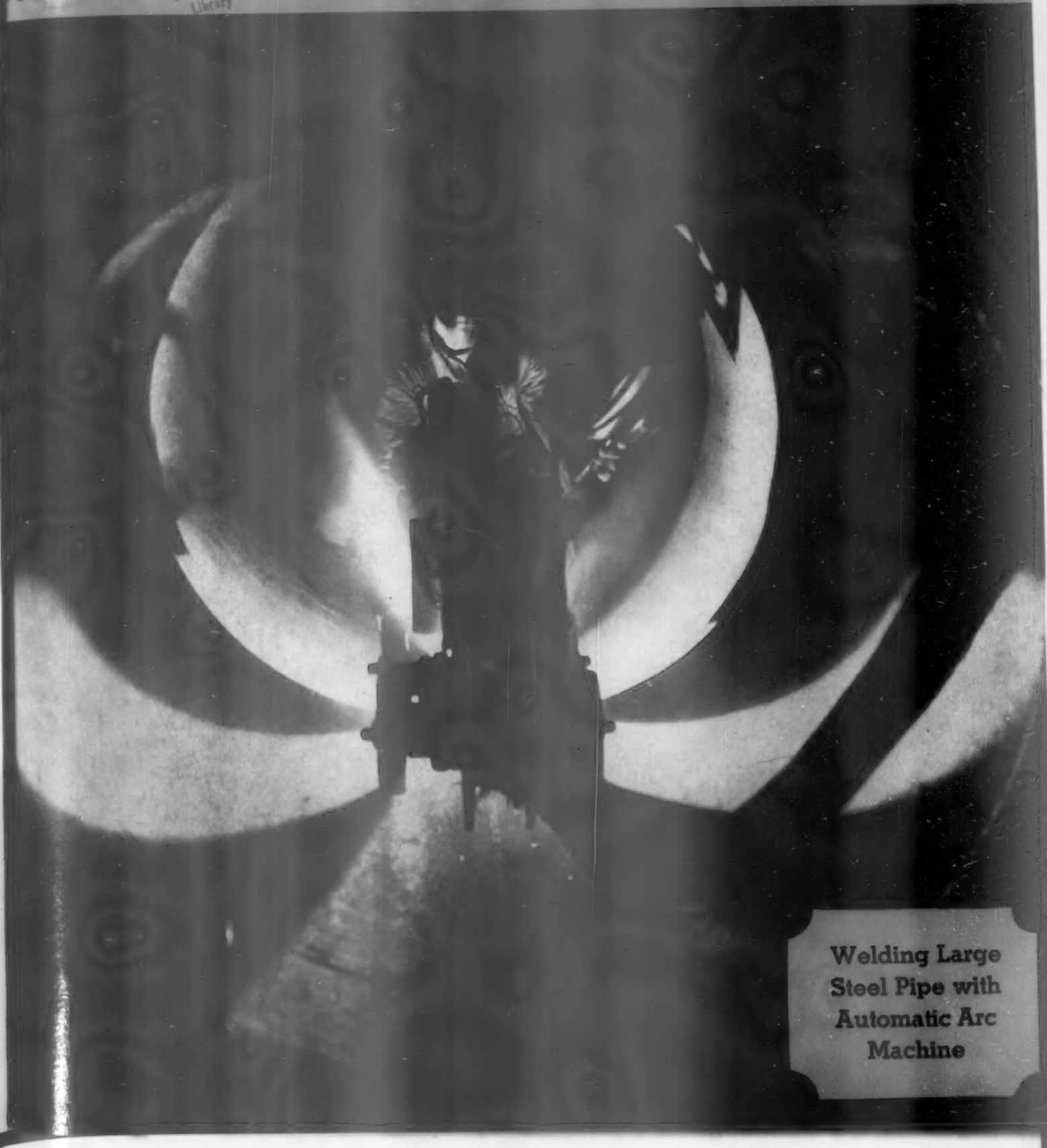
The Welding Engineer

IONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

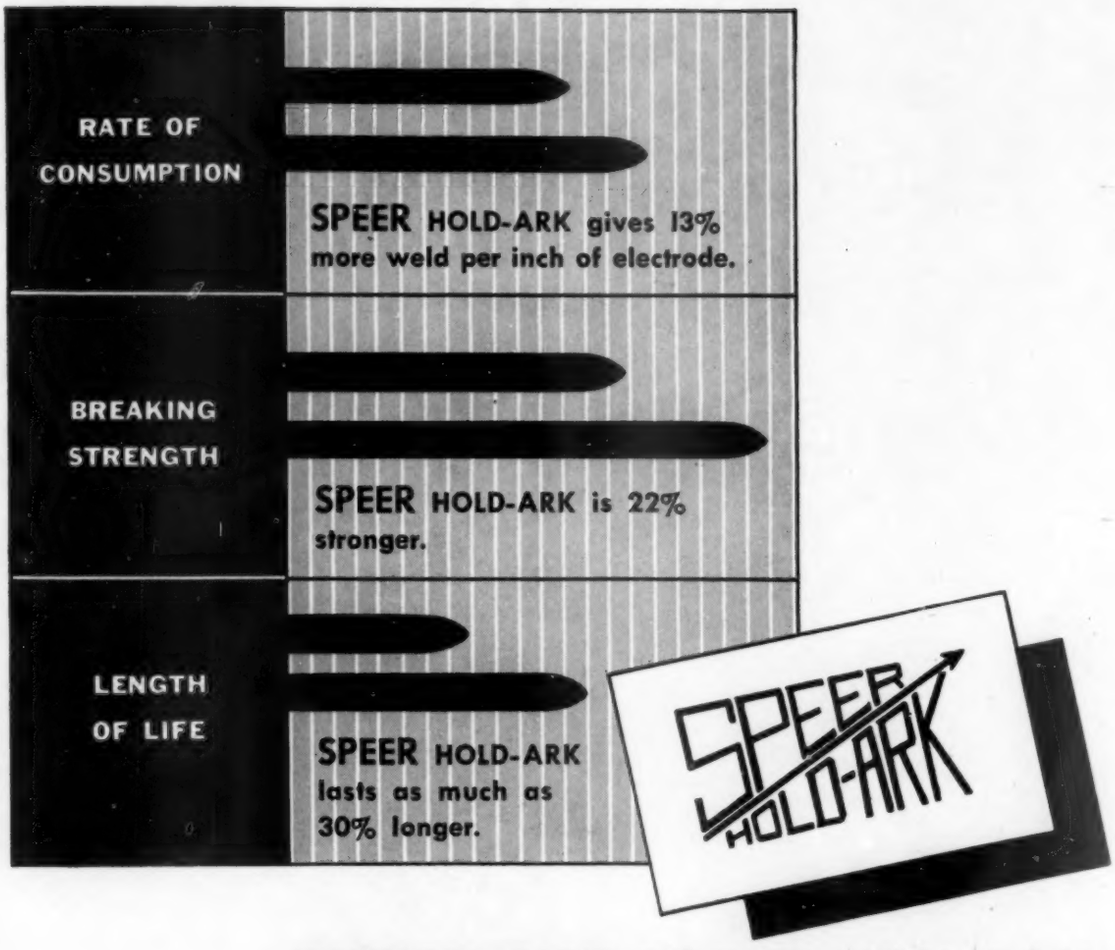
Volume XXIV November, 1939 Number 11

East Engin. Library

NOV 29 1939



Welding Large Steel Pipe with Automatic Arc Machine


RATE OF CONSUMPTION
SPEER HOLD-ARK gives 13% more weld per inch of electrode.
BREAKING STRENGTH
SPEER HOLD-ARK is 22% stronger.
LENGTH OF LIFE
SPEER HOLD-ARK lasts as much as 30% longer.
SPEER HOLD-ARK

THESE ARE FACTS YOU CAN PROVE ON YOUR OWN JOBS—*WITHOUT RISK*

Write for Booklet 60 and our proposition. Learn *why* SPEER HOLD-ARK electrodes are better. Learn *how* you can test them to your own satisfaction at *our* risk.

HOLD-ARK electrodes are the most recent development of more than forty years of SPEER research and improvement in carbon products.

You will find SPEER HOLD-ARK electrodes are real money-savers, so write today—for Booklet 60 and proposition.

SCC

SPEER CARBON COMPANY

ST. MARYS, PA. CHICAGO CLEVELAND DETROIT MILWAUKEE NEW YORK PITTSBURGH

9465

VOL. 24

NOVEMBER, 1939

NO. 11

The Welding Engineer

MEMBER

Associated Business Papers
Audit Bureau of Circulations
American Welding Society
International Acetylene Association

G. H. MACKENZIE
President and Treasurer

RALPH S. KENRICK
Editor

M. S. HENDRICKS
Promotion Manager

» «

Eastern Representative:
T. E. DEPEW, 1834 Broadway, New York, N. Y.
Tel. Columbus 5-7843.

Pacific Coast Representative:
W. R. McINTYRE, 446 Western Pacific Bldg.,
Los Angeles, Calif. Tel. Prospect 0585.

» «

Published on the 15th of each month by The Welding Engineer Publishing Company, 506 South Wabash Ave., Chicago, Ill.
Telephone Webster 7134.

Advertising copy must be received not later than the 5th of each month.

IN THIS ISSUE

Our Front Cover:

"Welding Large Steel Pipe with Automatic Arc Machine" symbolizes the "flash" and speed of production welding. Operator is using an "Electronic Tornado" automatic arc welder to join 3/8-in. plate into 51-in. diameter pipe for Colorado River aqueduct. Photo (Lincoln Electric Co.).

Welding Helps Steel Industry (Editorial) 17

Recent Developments in Flame-Treating Applications (J. H. Zimmerman) 19

Automatic Gas-Fired Heating Furnace Uses Welded Combustion Chamber 23

New Technical Literature 25

High-Lights of Recent A.W.S. Annual Meeting 26

Arc Welded Redesign of Power Shovel Turntable Bed (R. H. Zeilman) 29

Digests of Selected Technical Papers at A.W.S. Annual Meeting 32

Hard-Facing Effects Economies on Earth-Moving Equipment 40

Brief Sketches of Welding Jobs 42

New Product Developments 44

News of the Industry 46

Classified Section 53

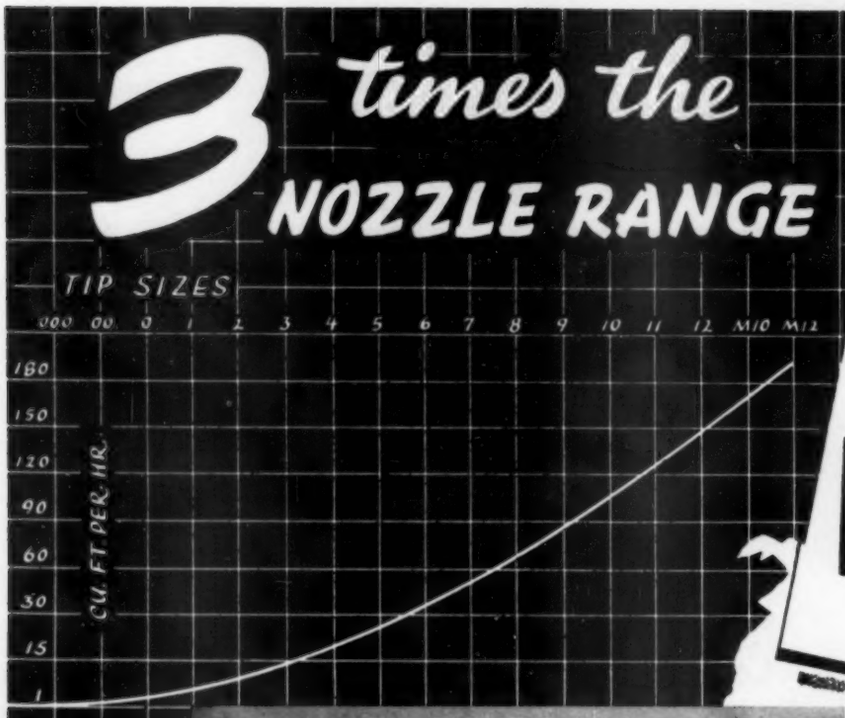
» «

Stone Crusher Built by Welding Flame-Cut Plates (W. J. Carle) 28
News of the Industry 46
Personals 46
A.W.S. Activities 48
Trade News 49
Recent Patents 50
Trade Literature 52
Classified Section 53

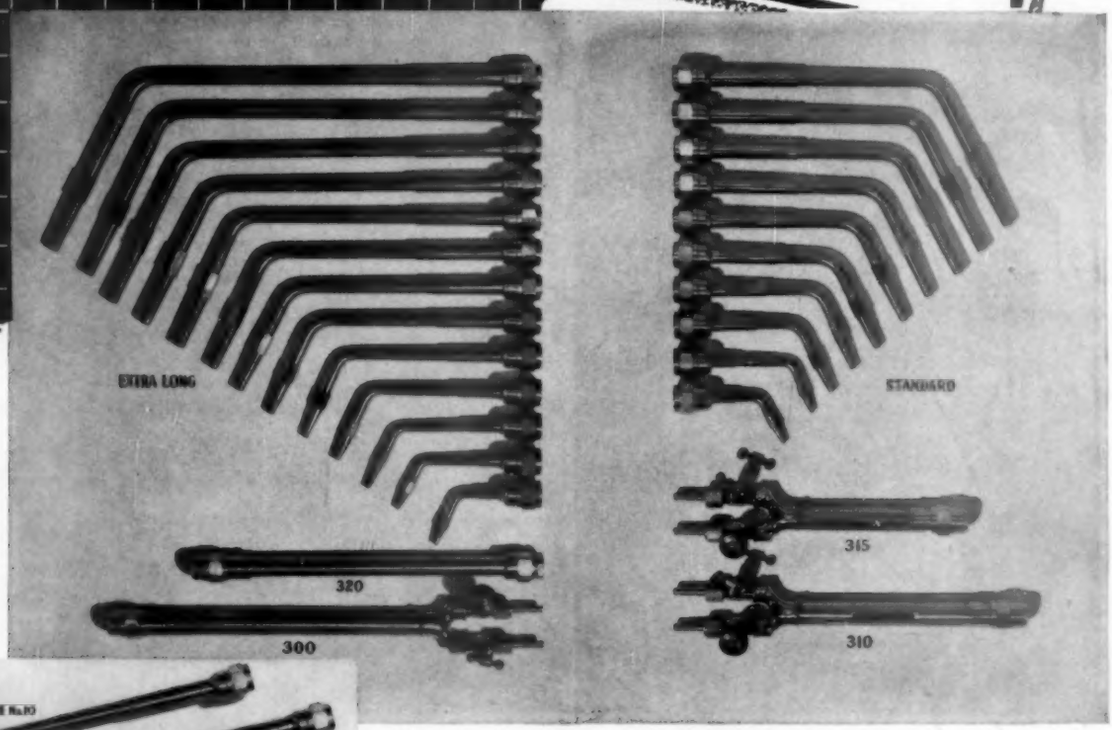
Subscription, payable in advance: United States and possessions, and Canada, $3 a year; Foreign Countries, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 35 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

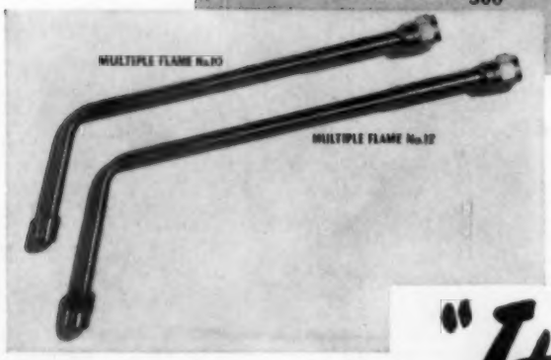
FOREIGN REPRESENTATIVES: AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; GREAT BRITAIN—A. D. Baynes, 6, Mordaunt House, Larkhall, Clapham, London, S. W 8, England; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa; JAPAN—Maruzen Company, Ltd., 6, Nihonbashi, Tori-Nichome, Tokyo, Japan; U. S. S. R.—Mesdunarodnaja Kniga, Kusnezki Most 18, Moscow, U. S. S. R.

3 times the NOZZLE RANGE



VICTOR FOR WELDING





Multiple flame heating nozzles with large gas capacity for bending or straightening operations.

No other welding torch offers the choice of nozzle types and sizes and the welding and heating range of the VICTOR "300" series torches, made in three over-all sizes, to meet the operator's preference.

"It costs less to own VICTOR"

Welding Helps Steel Industry

WELDING ENABLES the steel industry to hold existing markets through improvement in quality of fabricated steel products and through lowering of production costs. Welding has also opened up entirely new markets for the use of rolled steel as compared to other types of construction, such as castings, forgings, wood, concrete, plastics, etc. Lowering of production costs and improvement of quality, as in the automobile industry, has increased markets and widely extended the consumption of steel. Welding enables the railroads to achieve substantial economies in equipment costs and maintenance. This is particularly significant to the steel industry, because railroad prosperity is vitally important to the steel industry.

A high percentage of machinery is now being designed to utilize the advantages of rolled steel with or without the use of steel castings. Rather complicated contours can be produced at moderate cost by means of present day welding and cutting processes. Rolled steel is an inexpensive fabricating material which permits an economy in weight due to its higher unit strength and stiffness as compared with cast-iron. Additional economies are found in the reduced inventory of parts required by manufacturers, since a comparatively small stock of rolled steel sections can be integrated by welding into a variety of machine parts. Another important advantage of rolled steel is the assurance against defects which, in the case of castings, might not be revealed until after considerable time and labor had been spent on machining. By means of flame-hardening and hard-surfacing it is possible to subject wearing surfaces to special treatments that will prolong the life of the entire structure.

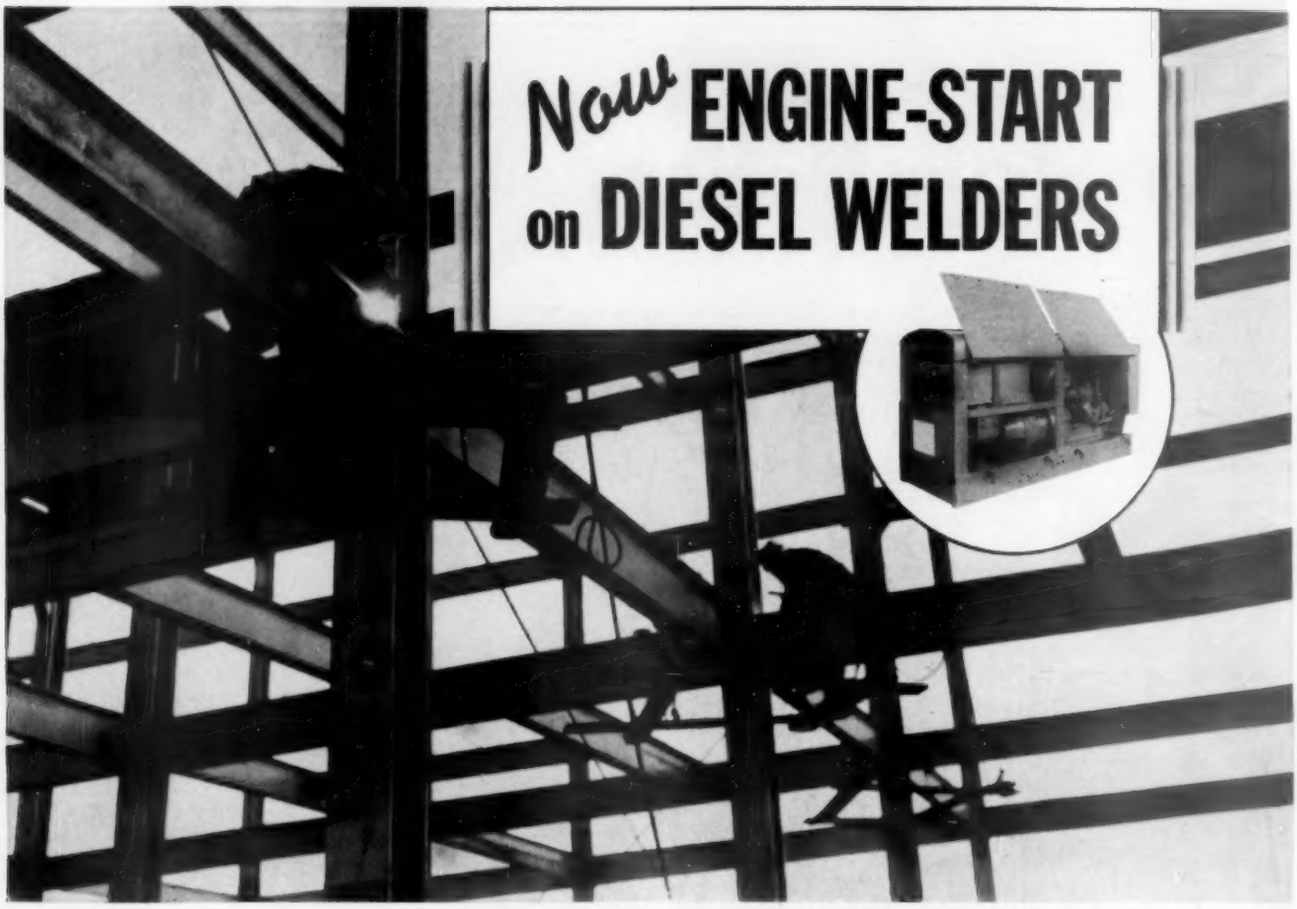
It is well recognized that practically all of the big pressure vessels are now fabricated by welding. A welded vessel can use thinner shell plates, with corresponding saving in material costs, than is possible with a riveted vessel. This is true because with riveted design the effective section of the shell is reduced by the rivet holes. An additional saving results from the fact that with riveted construction all seams and rivets must be caulked, whereas with welded fabrication the joint is inherently leakproof. Lap joints and butt straps are of course eliminated.

New uses for steel have been developed in the fabrication of pressure stills used in petroleum refining. High pressures and temperatures required in the cracking processes, demand the use of steel plate thicknesses greater than it is possible to join by means of riveting and caulking, regardless of cost. By means of welding, pressure stills of any diameter and all thicknesses and lengths can be manufactured, the only limitation being ability to transport the vessel to its destination. Thus, welding has made more economical production possible in the petroleum industry. It has been stated on good authority that the net cost of gasoline (at the refinery and exclusive of taxes) would be twice as great as it is now were it not for the availability of welded pressure stills.

Welding is also widely used in the fabrication of storage tanks. Tank sizes are going up from the 55,000 bbl. capacity of a few years ago, to tanks averaging 80,000 bbls. capacity. Recently a 150,00 bbl. tank was constructed by welding. The oil industry has found that welded tanks result in less maintenance expense. In fact welded fabrication is the preferred method in the manufacture of containers of sizes ranging from the smallest of merchandise containers to the largest storage tanks. No other method of construction provides a leakproof joint, which will develop a strength equal to that of the plate material.

Railroad passenger business has been stimulated to a profitable degree by means of the new welded streamline trains, the first one of which went into service in 1934. At the present time, there are more than 80 of these trains in daily operation on some 20 railroads and in each case this new equipment has brought additional passenger traffic and boosted net earnings. The adoption of stronger materials for locomotive and car construction, such as stainless and low-alloy steels, fabricated by means of welding, has reduced the weight of this equipment from 25 to 30%. Reductions in weight have permitted important fuel economies aggregating 10 to 15%. In the case of freight cars, reduction in dead weight, which is non-income producing, lowers operating cost. Welded steel freight cars have cut the weight of a standard 50-ton car from 47,700 lbs. to 35,600 lbs., a net reduction of 12,100 lbs.

The automotive industry is probably the greatest consumer of steel. The new models are one of the best endorsements of welding that can be found anywhere. The manufacturer of one of the popular low-priced cars has stated that his car contains 3,415 welds, of which 3,154 are spot welds, 217 are arc or gas welds and 44 are butt-flash welds. Welding permits the automobile designer to obtain greater strength with less weight and also reduces the assembly labor. In the motor truck and bus field, the use of welded stainless steel bodies has enabled reductions of 2,000 to 4,000 lbs. in dead weight, with resultant fuel economies. Low alloy, high tensile steels are also being used to an increasing extent in this field.



"Shield-Arc" *welding the framework of new 14-story state building in Kentucky.*

The engine-start diesel driven *"Shield-Arc"* welder now gives you—

1. EASY STARTING IN ANY WEATHER:—Faster starts in cold weather than with conventional engine driven welders!

2. SIMPLE STARTING EQUIPMENT:—Compact easily hand-cranked auxiliary engine mounted above the diesel. No worry about batteries.

3. LIGHT, COMPACT POWER:—A diesel comparable in weight and size to gasoline power.

4. INHERENT OPERATING ECONOMY:—Savings on fuel up to 40 cents per hour.

5. LOW FIRST COST:—Only slightly higher than gasoline engines of equal power and operating speed.

—These decisive advances in diesel design make the *"Shield-Arc"* the biggest money-saver in the welding field today.

Find out about the diesel driven *"Shield-Arc"*. Consult your nearest Lincoln office or mail the coupon.

Largest Manufacturers of Arc Welding Equipment in the World

THE LINCOLN ELECTRIC CO.

CLEVELAND, OHIO

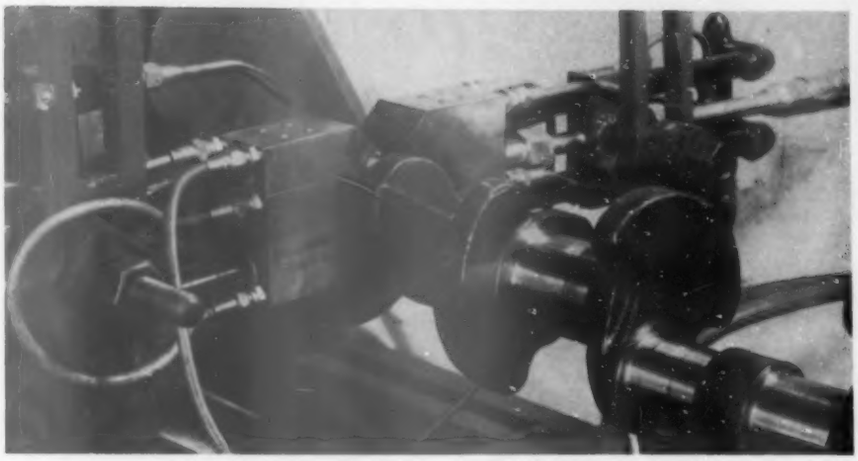
THE LINCOLN ELECTRIC COMPANY, Dept. CC-650, Cleveland, O.
Send full particulars about the Diesel *"Shield-Arc"* (Bulletin 327-A.)

Name _____ Position _____

Company _____

Address _____

City _____ State _____



Example of hardening by the spinning method. A close-up of a pair of crankshaft hardening heads. This is Fig. 5 in the series of captions. Photo (Linde).

Review of recent technical developments in

Flame-Treating Applications

★ Special shapes require unusual control of hardened zone contour—Flame-strengthening permits local intensification of physical properties in regions of high stress concentration

By J. H. ZIMMERMAN

Development Engineer, The Linde Air Products Co., New York City

FLAME-HARDENING as a heat-treating process has been defined as the surface-hardening of parts made of quench-hardenable material, accomplished by rapid heating of the regions to be hardened with the oxy-acetylene flame, and by subsequent cooling by the application of a suitable quenching medium. The principles involved are in no way different from those which have been the underlying essentials of any process of hardening by heat-treatment. The distinguishing feature of the process has been the inherent flexibility which permits hardening of such surfaces of a part as may require high hardness, without the hardening of sections wherein such hardness is not required, or where it may, in fact, be undesirable.

The flame-hardening process occupies a unique position in the field of heat-treating. It can be used as a substitute for full hardening and tempering or in conjunction with this same process. It frequently can be used as a substitute for, or an improvement on, other surface-hardening methods, such as case-hardening by carburizing or nitriding. In very rare cases only, however, does the process compete with hard-surfacing as accomplished by deposition of a wear-resistant material of widely different properties than the base metal.

Without going into detail regarding the competitive position of flame-hardening, it can be said that if surface hardness of certain regions only is desired, such hardness generally can be obtained by means of flame-hardening more quickly and more economically than by any other method. Where high core properties are desired, flame-hardening is not a substitute for full hardening, but must be used in conjunction therewith. Where high local surface hardness is required, flame-hardening frequently proves to be economical in comparison with other case-hardening methods. On the other hand, flame-hardening is not economical as applied to small parts which are usually carburized and hardened in bulk. Finally, as flame-hardening produces no changes in the composition of the metal hardened, it cannot serve as a substitute for the hard-surfacing processes which involve the deposition of special wear-resistant alloys.

In heating parts for surface-hardening by the flame-hardening process,

*Paper presented before the Annual Meeting, American Welding Society, Chicago, Ill., October 25, 1939.

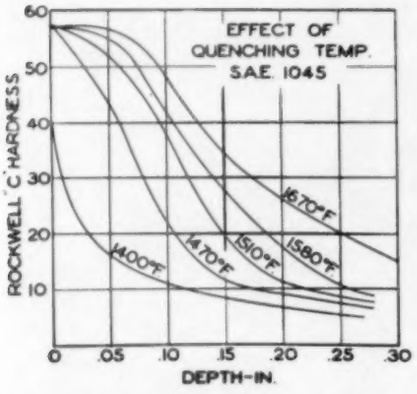


Fig. 1—Curves showing relation between surface temperature, as measured by means of an optical pyrometer, and case hardness contour.

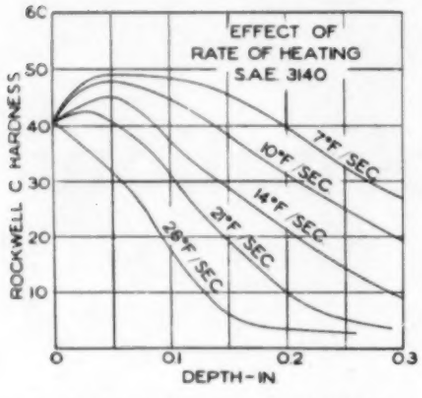


Fig. 2—Curves showing relation between rate of heating and case hardness contour.

the high heating value of the oxy-acetylene flame has made possible the great degree of flexibility of the process. Considerable variation in degree of hardness and case depth can be obtained through proper manipulation of the flames.

In quenching, it may be said very simply that the same principles of cooling that apply in other methods of heat-treatment apply in this instance. The faster the rate of cooling from above the critical temperature, the greater the degree of hardness. In certain instances it has been found possible to produce higher surface hardness in a given material by the flame-hardening method than can be obtained by any other method of heat-treating. This is because of the steep temperature gradients which may be obtained in heating the surface metal to a suitable hardening temperature, with the subsequent rapid flow of heat to the cold base metal beneath, in addition to the usual flow of heat to the externally applied quenching medium. Obviously, this extreme quenching action is not to be obtained on the surface layer of a part which has been heated to hardening temperature throughout.

In the course of locally hardening the surface regions of a part, the volume changes involved are of insufficient magnitude to do more than set up residual strains of a minor order. These may be effectively eliminated or minimized by a tempering treatment at 350 to 400 deg. F. This treatment must be recognized as a necessary part of the flame-hardening process, as is the case in all other quench-hardening processes. The tempering or drawing may easily be accomplished by means of an oil bath or oven.

Depth of Hardened Zone

The two principal features of importance in applying the flame-hardening process are the hardness and depth of the hardened zone. In general, the hardness obtained is quite closely allied with the rate of cooling, although it is obvious that the attempt is made to secure too deep a case, some hardness must be sacrificed through diminution of the quenching action because of slower rates of cooling. The depth of case can be controlled within reasonable limits by the intensity of heat application prior to quenching.

These principles are illustrated as follows:

In Fig. 1, the relation between quenching temperature and depth of case is shown. It is obviously impossible to maintain a uniform temperature throughout the zone at the ideal temperature only slightly above the critical. However, it has been found that because of the heat of transformation, quite appreciable case depths may be obtained with attendant grain refinement. As would be expected, the more rapid rates of heating produce the thinner cases, other factors being constant, as is shown in Fig. 2.

The following illustrations are intended to describe the several methods of flame-hardening, their effects upon a number of engineering materials, the type of apparatus and machinery employed, and in a general way, the results that may be expected with proper application of the process.

METHODS—There are four general methods of producing surface hardness by means of the oxy-acetylene flame. These are referred to as stationary, progressive, spinning, and combination hardening. The latter method involves a combination of spinning and progressive motions.

In the stationary method both the work and the heating flames are stationary and contact is maintained for such time as may be necessary to heat the surface metal to the required temperature and depth. The heating is followed by suitable quenching. This method is illustrated by Fig. 3. In this application the ends of the valve stems to be hardened may be either slightly below or slightly above the surface of the quenching bath, depending upon the material and section.

The progressive method of hardening involves passage of the heating flames along the surface to be hardened, closely followed by passage of a suitable quenching jet or spray where necessary. In the case of self-hardening steels the quench may be omitted. Special heads employed in the progressive hardening of printing press clip ways are shown in Fig. 4. In this is illustrated the relationship between the flame and quench drillings. Attention is called to the excellent contour control obtained in this application.

The spinning process involves rotation of the work before a group or groups of heating flames so located as to produce the desired hardness contours with the subsequent application of quenching sprays or other cooling means. A crankshaft bearing spinning set-up is shown in Fig. 5. In this case the shaft is revolved between two heads which include both heating and quenching drillings.

The combination hardening method involves spinning of the work piece and progressive travel of the heating and quenching apparatus. This process is illustrated by the experimental roll hardening machine shown in Fig. 6.

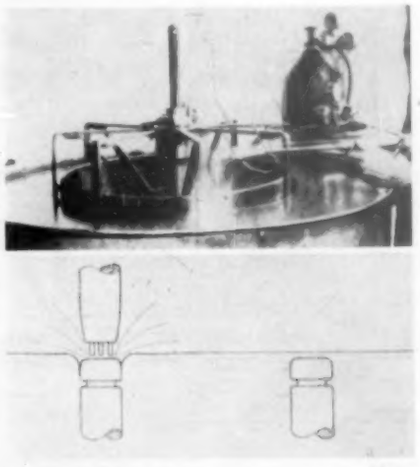


Fig. 3—"Spot" flame-hardening of valve stem ends. They are submerged in a tank of water.

in which a rotating roll is subjected to progressive application of heating flames and quench.

Surface Hardening Materials

MATERIALS—While a wide range of materials may be successfully flame-hardened, by far the most popular material is the plain carbon steel of the S.A.E. 1045 type. This steel has been found to be responsibe to surface hardening to an extent sufficient for most applications. It is readily available and relatively inexpensive. It was at first suspected that the deep and shallow hardening steels, so-called because of their response to hardening by other methods, might respond differently to the flame-hardening process. As a check, two S.A.E. 1045 steels of close chemical compositions but of A.S.T.M. grain size 2-4 and 6-8, respectively, with corresponding deep and shallow hardening characteristics, were investigated and found to react to the process in an identical manner.

Improved core properties, compared with those obtained by preheating the plain carbon steels, may be obtained by the usual recourse to alloy steels. Steels of the S.A.E. 3100, 4100, and 6100 types have been pretreated to give exceptionally good core properties and subsequent local flame-hardening has produced the requisite surface hardness in excess of the core hardness. The expected interior zone of low hardness in pretreated steels is present in most cases but to an almost negligible extent. By this is meant that in passing from the high surface hardness to the normal core hardness of the pretreated alloy steel, the zone which has been tempered to a higher temperature than that to which the entire part was subjected in pretreating has not been appreciably softened by the flame-hardening. The time element and the sluggishness of reaction of the alloy steels are probably responsible for this helpful condition. Very little difference is to be observed in the microstructure of flame-hardened alloy steels as compared with the structure of plain carbon steels of equivalent hardenability.

Early in the introduction of the graphitic steels, experimental work was conducted to determine the practicability of supplying the flame-hardening process to this material. Unusually coarse martensitic structures have been obtained in the flame-hardening of such steels, but the coarsening has not been found to be disadvantageous in the service performance of flame-hardened graphitic steel parts.

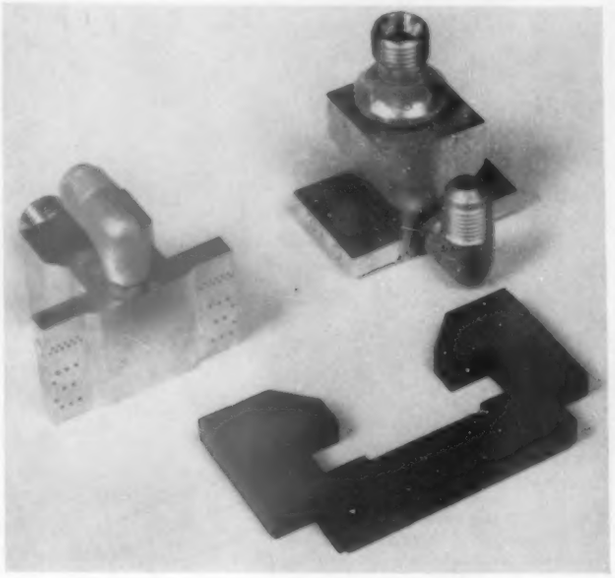


Fig. 4—Special "progressive" type flame-hardening heads for the treatment of printing press clip ways with a macro-etched section of a hardened way. Note the excellence of contour control at the four hardened surfaces.

In the flame-hardening of the cast ferrous materials, no difficulties have been encountered in the hardening of steel castings in numerous applications. It should be understood in this instance, of course, that flame-hardening will not produce high surface hardness on a decarburized surface. Flame hardening on machined castings where such irregular surface conditions have been removed, has resulted in uniformly acceptable hardnesses.

Cast-Iron Limitation

In the hardening of gray cast iron, difficulty may be encountered where the combined carbon content does not fall within the range of 0.50 to 0.80 per cent. Irons containing less than 0.50 per cent combined carbon will not develop maximum hardness, while those having combined carbon in excess of 0.80 per cent are liable to crack. Usually, any iron which falls within the A.S.T.M. classifications of 35 to 50, inclusive, can be flame-hardened satisfactorily.

Misleading results have been reported in the hardening of cast irons because of the difficulty experienced in accurately measuring the surface hardness. Irregular impressions are obtained in penetration hardness tests of flame-hardened cast iron because of local shattering. Irregularities in test results, traced to this difficulty, have been eliminated by check tests using the Scleroscope with great care.

In the flame-hardening of malleable cast iron, satisfactory results have been obtained. Most commercial applications have involved the hardening of castings on "as-cast" surfaces. In such instances, full case properties have been developed slightly below the surface because of the thin skin of pure iron characteristic of black heart malleable castings. This thin layer of soft material has not been considered objectionable because, after only a relatively small amount of wear, the hard flame-hardened metal presents itself, and the resistance to further wear is correspondingly increased. If maximum hardness is desired at the surface of a malleable part, it is necessary to machine off the carbon-free layer. Investigations to date indicate, however, that, whereas malleable castings have been successfully flame-hardened, this material is not to be recommended except where ex-

---

While flame-hardening, as a process, needs no special introduction to the heat-treater, metallurgist or engineer, it is believed that certain recent developments which have not been publicized to any appreciable extent, and certain allied processes which have been developed as outgrowths of flame-hardening may be of interest. In this paper are described certain of the more recent applications of the flame-hardening process to special shapes requiring unusual control of contour of the hardened zone, and to special materials to which the process has been applied only recently with success. The general subject of flame-softening is discussed in some detail with particular respect to the important part played by this process in the oxy-acetylene cutting of the hardenable steels. In addition, consideration is given to the relatively new idea of utilizing the oxy-acetylene flame as a means for locally increasing the physical properties of highly stressed parts in regions of high stress concentration.

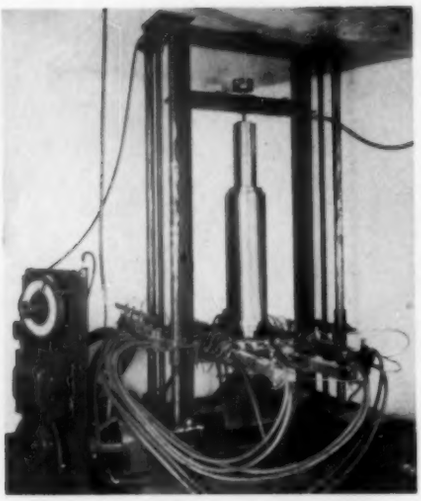


Fig. 6—Experimental roll hardening machine with 10 in. diameter knurled roll in position for hardening by the "combination" method.

treme close control of the process can be maintained.

Excellent results have been obtained with the special types of cast materials which do not fall into the recognized classifications other than the somewhat vague group of materials which might properly be termed "semi-steels."

Apparatus Available

APPARATUS—Various papers on the subject which have appeared in the literature during the past year or so have illustrated the types of apparatus employed in the flame-hardening process. From the apparatus manufacturer's viewpoint the equipment divides itself into two groups, the first of which includes the parts which are used to a sufficient extent to warrant manufacture in quantity, and which are therefore considered as stock items; the second group comprising the special equipment which is developed to produce the necessary results in specific applications.

Early in the development of the process, it became apparent that gears in the sizes ranging from 1 to 3 D.P.* would lend themselves admirably to the process. It was not long therefore before so-called "standard" or "stock" flame-hardening heads for gears in this group were available.

In examining heads specifically designed to harden gears with the requisite contour it will be noted that the flame spacing is closer toward the root of the tooth and that the quench drillings follow very closely after the flames. The proper spacing of the flame has been developed after considerable experimental work in order to compensate adequately for the variation in mass effect between the top of the tooth and the root.

*Diametral pitch.

Removable Insert Tips

A somewhat different type of stock apparatus is available in the form of removable tips of various lengths which may be inserted into standard multi-flame heads for various numbers of flames. By blanking out certain positions in such heads and employing insert tips of various lengths, considerable flexibility of standardized equipment can be obtained in handling the hardening of parts of a wide variety of shapes and dimensions. Insert tips in standard multi-flame heads have, for example, been used in successfully producing the required contour and hardness in the hardening of pipe wrench jaws. It should be understood in this application that the wrench jaws are assembled side by side and treated by a continuous progressive hardening. Obviously, compensation must be made for the mass effect, and heat input is therefore varied by blanking out tips to provide for the desired contour.

There is practically no limit to the types of special heads which may be developed to meet specific needs. As an example of this, there may be mentioned custom-built drilled-face crankshaft hardening heads with integral quench. Unfortunately, heads of this type are limited to a relatively small range of dimensions in the hardening of crankshaft bearings, providing the required hardness contours are exacting. In these heads the heating flames are spaced to provide for variations in mass effect.

A somewhat different type of special flame-hardening head may be made up as an assembly of small standard heads, special clamps, and auxiliary quench as employed in the hardening of rolls by the combination method.

MACHINES—In addition to the gas-handling apparatus essential in the process, various types of machines are also required as motivating units. Here again, types of equipment vary with nature of the work.

The portable cutting machine has been used for progressive flame-hardening since the beginning. Many other machine types have been employed with success, the only requirements being that the machine must be capable of acting as a steady support for the heating and quenching equipment and capable of moving the hardening apparatus along the work surface at a proper speed, and at a proper distance from the surface to be hardened.

In using the spinning method many types of lathes have been quickly and cheaply converted to suitable flame-hardening machines, as shown in Fig. 5. Where the work is quenched while spinning, heating heads with integral quench such as illustrated in Fig. 5, or heating heads with an auxiliary quench may be used. It is also possible to quench the heated work quickly in a suitable bath by means of a quick-releasing chuck. The latter practice is recommended for the spinning process when the composition of the material requires an oil quench in order to obtain the desired case.

The combination hardening method employing both spinning and progressive motions has found a wide application in the flame-hardening of rolls, shafts and liners. A special flame-hardening machine employed in the hardening of shafts or rolls is shown in Fig. 6. In either case the work piece is revolved and the heating flames and quenches progress from one end of the hardened area to the other.

A somewhat similar machine has been designed for the hardening of the interior of cylindrical pump liners. In this machine, as in the previous case, the liner is rotated as the internal hardening head and quench head are traversed longitudinally.

(Concluding installment of Mr. Zimmerman's paper will be published in the next issue.)

» «

A 10-ton rock crusher base fabricated by welding. Photo (Airco).

Fig 1—Spot welding the two halves of the pressed steel combustion chamber to prepare it for seam welding.

Automatic gas-fired heating furnace uses

Welded Combustion Chamber

★ Pressed steel sections of 19 gauge copper-bearing low-alloy steel are seam welded to form a corrosion-resistant heat exchanger section

CAST-IRON HAS DOMINATED the small furnace field for many years. It is still the preferred material for coal-fired heating furnaces, but welded steel is now "crowding it" seriously in the oil-fired and gas-fired heating line. The L. J. Mueller Furnace Co. of Milwaukee, Wis., one of the oldest manufacturers in the industry (established 85 years ago), has successfully pioneered in the development of a pressed steel combustion chamber for a gas-fired home heating furnace. The two half-sections are seam welded together as shown in Fig. 3. A very important consideration is the composition of steel sheet used. Much experimental development work had to be done before a suitable low alloy steel was found which possessed both the desired degree of corrosion resistance and the ductility needed for heavy drawing operations. The Mueller Co. states that this is a copper-bearing low-alloy steel of 19 gauge. Two drawing stages are required in a 500-ton press to form each half of the "Heat Speeder" section, as it is called by the manufacturer.

The "Heat Speeder" section is made up of two halves, one having four horizontal convolutions, the other three, which fit together in such a manner as to give a narrow flue passage for the products of combustion, and also a wiping action to increase the heat transfer. In addition, baffles are inserted at each convolution to restrict the flow of gases and to augment the wiping action. Angle iron frames are welded to the two front openings of the heating section to provide support and to frame the insulated upper clean-out cup and the lower cast-iron

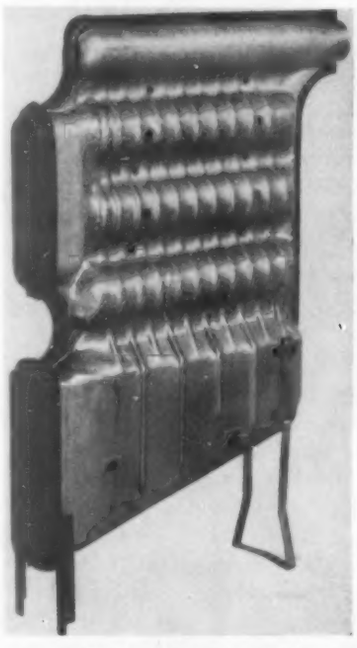


Fig. 2—How the completely welded "Heat Speeder" section looks when ready for assembly into a Mueller furnace.

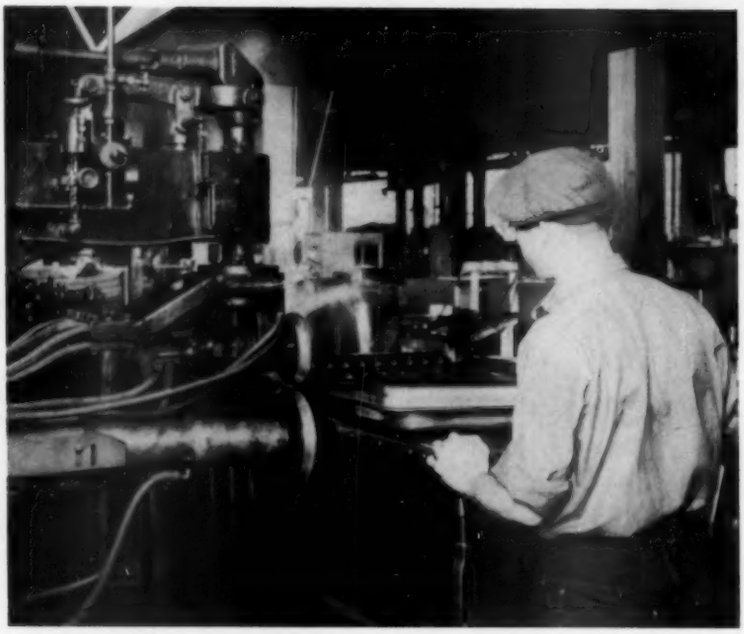


Fig. 3—With this 100 kva. seam welder, a "Heat Speeder" section is welded in 45 sec. Wheel speed is 9¾ lineal feet per min.

Fig. 4—An oxy-acetylene torch is used to weld the edges near front openings which cannot be reached by the seam welder.

burner door assembly. Following is a description of the manufacturing sequence:

(1) Burner support lugs, casing lugs, and baffles are spot welded to their respective sections.

(2) The two halves are jigged together, clamped in position and spot welded together for seam welding (see Fig. 1). It will be noted that each section has a ¾-in. overlapping edge for seam-welding purposes. The assembled halves are laid on a metal table adjusted to the height of the 100 kva. seam welder and the overlapping edges are fused together between the rotating wheels of the seam welder. A cam operated timer is used for "stitch" welding, the peripheral speed of the seam welding rolls being 9¾ ft. per min. With this speed, a "Heat Speeder" section is seam welded in 45 sec. The feed is automatic being governed by the speed of the seam welding rolls. These latter are a copper-base alloy of suitable hardness. Wheel dressing is required about every 100 welded "Heat Speeder" units.

(3) The clean-out angles and burner box angles, press-formed, drilled and tapped are next spot welded in place to frame the two front openings of the heating section.

(4) The section is then jigged up and hammered and fitted to exact shape; portions of the overlapping edge near the front openings which cannot be seam-welded are fused together with an oxy-acetylene torch.

(5) The unit is then complete except for testing under low air pressure and for the final inspection of baffles and lug positions.

Welded Blower Rotor

In the Mueller winter air conditioning system, air is circulated under pressure to each room in the house by means of a motor-driven blower which is an integral part of the Mueller furnace. This blower also creates a suction in the cold air return ducts and thus completely circulates and filters the air in the house. The blower wheel is simple in design, but very rugged in construction, consisting simply of a center disc riveted to a die-cast hub to which disc are spot welded the air impelling "floats" or blades. These floats are formed from cold rolled steel to the proper radius, with stiffening ribs at the base of the "float" to give greater rigidity.

Fig. 5—Assembling the blower rotor by a manually-controlled spot welding jig which accurately positions and then welds two "floats" to the center disc. Automatic indexing is used.

The most interesting part of the wheel construction is the method of attachment of these "floats" to the center disc. Figure 5 shows the special spot welder, pneumatically-controlled, operating in a horizontal plane, and the patented wheel-welding device. This welding device indexes to give identical spacing for all pairs of "floats," and the same positioning for all spot welds. Since this spot welder is automatically controlled as to intensity and duration of current, pressure and duration of pressure, uniform welds are produced. The precision of this machine is shown by the fact that these rotors require little balancing after the "floats" have been spot welded in place, due to the excellent uniformity of welding obtained in this simple jig.

» «

Technical Literature

We have listed below brief reviews of new technical literature prepared by welding equipment manufacturers. Any literature you may desire will be sent to you free of charge. Merely check or mark serial number of paragraph on order blank at bottom of page. No obligation.

Neotron Weld Timer

(141) Electric Controller & Mfg. Co. has a 4-page folder (No. 1201) describing the features of the new Neotron weld timer for spot, butt and projection welding. This unit provides accurate timing over entire welding range of machine.

Welding of White Metal

(142) Aladdin Rod & Flux Mfg. Co. has instruction bulletins available, one detailing the welding of die-cast metal and the other covering the soldering of aluminum.

Wilson "Hornet" Bulletin

(143) A well-illustrated 18-page bulletin has been issued by the Wilson Welder and Metals Co., describing its new arc welding generator, sold under the trade name of Wilson "Hornet." Operating characteristics of the "Hornet" are treated in considerable detail, including such features as exterior design, adjustment, self-contained exciter, locked polarity reversal and single-pole control.

M.S.A. Welding Helmets

(144) Mine Safety Appliance Co. has just issued a four-page folder describing its line of welding helmets and accessory protective equipment. The line includes new one-piece models and also the older line of fabricated helmets. Also described are M.S.A. special helmets with wire screen shields and chrome leather helmets for special industrial applications. Protective clothing is also listed.

Hard-Facing Booklet

(145) Dymonhard Corp. of America has issued a descriptive booklet describing its new line of hard-facing alloys, which are available for both electric arc and oxy-acetylene application. Dymonhard facings are available for every application, such as abrasion, corrosion, strength and toughness at red heat and also for resisting impact. It is stated that these facings are applied by actual fusion to the base metal and not by brazing.

Welding and Cutting Equipment

(146) A 36-page pocket-size catalog describes the complete Rego line of welding and cutting equipment. This catalog also contains recommended tip sizes for welding various thicknesses of metal, and also tip sizes and gas pressures for flame cutting of iron and steel from 1/16 to 18 in. thick.

Safety Clothing

(147) The Steel-Grip line of safety clothing, including gloves, aprons, leggings and arm protectors, is covered briefly in a folder just issued by the Industrial Glove Co.

McKay Welding Electrodes

(148) A 24-page pocket size catalog just issued by the McKay Co. includes the new joint tentative specifications for iron and steel arc welding electrodes as approved by A.W.S. and A.S.T.M. This is the first publication of the joint tentative filler metal specifications.

Flame-Cleaning and Dehydrating

(149) Air Reduction Sales Co. has issued an 8-page booklet discussing this new process, which prevents paint flaking on new structural steel and plate. A diagrammatic sketch is included showing the operation of flame-cleaning and dehydrating.

Anti-Freeze for Air Lines

(150) The Sullivan Machinery Co. has a bulletin available describing the application of "Tannergas" for temporary air compressor installations, and also the application of "Frosto" for installations where electric current is available. Both products are guaranteed to prevent air line freezing at temperatures as low as 70 deg. below zero F.

Industrial Head and Eye Protection

(151) Chicago Eye Shield Co., 2300 Warren Blvd., Chicago, Ill., has published a 48-page booklet listing its complete line of goggles, respirators, spectacles, masks, welding helmets and other safety devices. Advice is given as to what type of protective equipment a worker should wear, particularly when exposed to ultra-violet and infra-red rays. Recommendations are included also as to types of respirators for toxic gases, fumes, dusts, etc.

Paint Burning

(152) An 8-page booklet issued by Air Reduction Sales Co. describes the method of halting deterioration of old steel structures by means of paint burning and surface conditioning. It is stated that structures thus treated recently include the Golden Gate Bridge at San Francisco, Calif.

High-Speed Grinders

(153) Sawyer Electrical Mfg. Co. has a new catalog covering its complete line of aerial grinders and high-speed heavy duty tool post and pedestal grinders. Information is also presented on the Sawyer Master pressure blowers, volume blowers, and the Sawyer - Smithway portable submersible pump. A complete line of sanders is also listed.

Maintenance of Portable Electric Tools

(154) Black & Decker Mfg. Co. has a 12-page booklet giving helpful ideas as to care and maintenance of portable electric tools. Included also are methods of grounding tools to protect the operator and suggestions to the maintenance man, giving him practical pointers on what to look for when a portable tool fails to operate.

THE WELDING ENGINEER — **November, 1939**

506 So. Wabash Ave., Chicago, Ill.

Please send me the literature as checked [X] on the list below:

141 ☐	144 ☐	147 ☐	150 ☐	153 ☐
142 ☐	145 ☐	148 ☐	151 ☐	154 ☐
143 ☐	146 ☐	149 ☐	152 ☐	

(To be sure of receiving literature ordered please indicate below your company affiliation and position.)

Name .....

Street Address .....

City ..... **State** .....

Company Affiliation .....

Position .....

Dr. Comfort A. Adams presents the Miller Medal to C. J. Holslag for his "pioneering in the development of a-c. arc welding and covered electrodes."

High lights of the recent successful

A.W.S. Annual Meeting

★ Simultaneous technical sessions prove to be excellent attendance stimulant. Chicago area gives definite evidence of interest in progress of welding and allied processes

WELDING PROCEDURE, welding applications and results of research activities, occupied the attention of nearly 1500 welding men who attended the recent annual meeting of the American Welding Society in Chicago. The registered attendance of 1473 comprised about 40 per cent of the membership. At the National Metal Exposition, which was held at the International Amphitheatre, the exhibits totaled 83,000 sq. ft. of floor space and the registered attendance was reported at 32,249. By all standards, this was the most successful Metal Exposition ever held, both registration and public attendance being greatly in excess of previous years.

Presentation of the Lincoln Gold Medal for 1938-39 and the 1938 Miller Memorial Award featured the opening session on Monday morning, October 23. The Miller Medal, which commemorates the contributions of Samuel Wylie Miller to the science and art of welding, was presented to C. J. HOLSLAG, president, general manager and chief engineer of the Electric Arc Cutting and Welding Co., Newark, N. J. DR. COMFORT A. ADAMS, past president of the A.W.S., and distinguished engineer and scientist, in presenting the medal said: "The Miller medal was presented for Mr. Holslag's very able pioneering in the development of a-c. arc welding and covered electrodes."

Award of the Lincoln Gold Medal, donated to the A.W.S. every year by James F. Lincoln, Cleveland, Ohio, was made in duplicate to G. O. HOGLUND of the Aluminum Co. of America, New Kensington, Penn., and G. S. BERNARD, JR., of the Aluminum Cooking Utensil Co., also of New Kensington. Presentation of the Lincoln Medal was made by CHARLES H. JENNINGS of Pittsburgh, Penn.

The award was based on the technical paper "Effect of Current Pressure and Time on the Shear Strength and Structure of Spot Welds in Aluminum Alloys." A requirement for this award is that the paper shall be published in The A.W.S. Journal, or presented before one of the Society meetings. This year's award paper was presented at the 1938 annual meeting of the Society.

David Levinger, assistant to vice-president and works manager of Western Electric Co. started the "ball rolling" with an inspirational keynote address.

George T. Horton was installed as the new president of the Society at the Friday morning (October 27th) annual business meeting. He will handle this new job along with his heavy responsibilities as president of the Chicago Bridge & Iron Co.

Harry C. Boardman concluded a very active year in the service of the Society and set a mark which his successor (and "superior" in the Chicago Bridge & Iron Co.) will have to "shoot at." "Harry" has been an extremely busy traveler (mostly by plane) during his A.W.S. stewardship.

Annual Business Meeting

At the annual meeting held Friday morning, October 27, HARRY C. BOARDMAN, as president of the Society, presented his annual report. This was followed by installation of new officers for 1939-40. GEORGE T. HORTON made a brief acceptance speech as the new president of the American Welding Society.

In presenting his report Mr. Boardman said in part, "Foresighted and wholehearted support by individual members, sections, committee chairmen, headquarters' staff and industry generally, has enabled the Society to effectively carry on and expand the work of its technical and research committees."

Two new committees were organized during the past year: (1) Machinery Code, (2) Rules for Field Welding of Storage Tanks. In addition, the following new committees have been authorized and are in process of organization: (1) Minimum Requirements for Welding Instruction in Trade Schools, (2) Non-Destructive Tests, (3) Welding of High-Alloy Steel Structures, (4) Nickel Alloy Structures, and (5) Grouping of Materials According to Weldability.

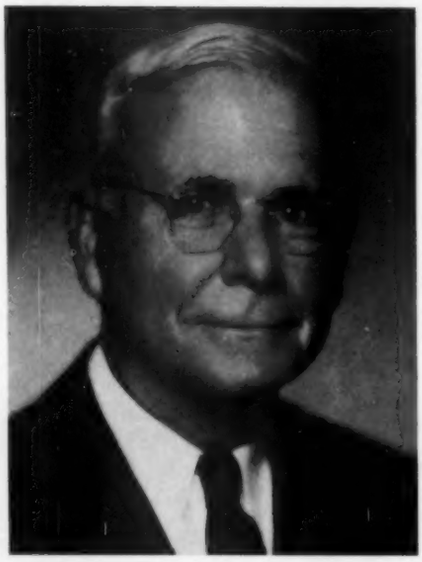
Three new Sections have been organized during the past year: (1) Puget Sound, with headquarters at Seattle, organized April 17, 1939; (2) Louisiana, with headquarters at New Orleans, organized May 12, 1939; (3) Quad-Cities, comprising Davenport, Iowa, Rock Island, Moline, and East Moline, Ill., organized April 12, 1939.

The Membership Committee reported a net gain in membership of 155 during the year ended October 31, 1939. This was an increase of 4.4 per cent, from 3538 a year ago to 3693.

Charles H. Jennings of East Pittsburgh, Pa., awards the Lincoln Gold Medal (in duplicate) to co-authors: G. O. Hoglund and G. S. Bernard, Jr., both of New Kensington, Pa., for their 1938 paper on "Shear Strength and Structure of Spot Welds in Aluminum Alloys."

Committee Progress

COMMITTEE ON CODE FOR PRESSURE PIPING—The Committee on Pressure Piping of the American Welding Society is identical with the American Standards Association Sectional Committee on Code for Pressure Piping, Subcommittee No. 8, Subgroup No. 4. During the past year the Committee has held several meetings and has about completed its assignment.



Eugene A. Balsley, currently chairman of the Chicago Section, A.W.S., helped a great deal through committee activities to guide the Chicago annual meeting and establish a new record of performance in Society conventions. He is welding engineer at Link-Belt Co.

MACHINERY CODE—This Committee was recently appointed but has been extremely active. As a result the Committee has prepared the first draft of the Tentative Code which has been submitted to the members for their approval. Subcommittees have been appointed to cover special portions of the code.

COMMITTEE ON FILLER METAL SPECIFICATIONS—The Committee has undertaken revision of the Filler Metal Specifications issued in 1938 with the idea of their simplification. Separate specifications will be issued for gas and arc welding. The arc welding specification has been prepared in preliminary form and is being submitted to a number of people for comments and criticisms. It is expected that this specification will be issued as a joint specification with the A.S.T.M. As soon as issued, corresponding specifications will be undertaken for gas welding and for alloy steels and nonferrous materials.

» «

NOW IS THE TIME
To Join the
AMERICAN
WELDING
SOCIETY

Stone Crusher Built By Welding Flame-Cut Plates

By W. J. CARLE*

★ A recent experience well demonstrates how quickly machine flame cutting is adopted by fabricators of heavy machinery, once the economy of this process is made evident to them. We were given permission to make a thorough survey of production problems in a middle-western plant manufacturing stone crushers, gravel washers and road construction equipment. Cost reduction was our primary objective.

As an initial step, following our preliminary survey, we obtained permission to install a No. 6A Oxygraph on a 30-day trial basis. During the initial period of use of the flame-cutting machine, it was possible to demonstrate enough cost saving on production work to warrant purchase of the machine. Since then, various parts of this company's rock crushing equipment have been changed over from castings to welded fabrication. Examples are illustrated in the photographs shown herewith.

Figure 1 illustrates a stone crusher base as made of a steel casting, while

*Air Reduction Sales Co.

Fig. 1—Cast steel stone crusher base.

Fig. 2 illustrates a new design of weld-fabricated base, using 1½ in. and 2 in. steel plates flame-cut and then arc welded with Airco No. 78 and 83 electrodes. It will be noted that the welded bases compares very favorably in appearance with the former cast steel base. Among the advantages realized by the customer are reduced costs, elimination of patterns, and better control of every step from delivery of steel plates at the plant to the last assembling operation.

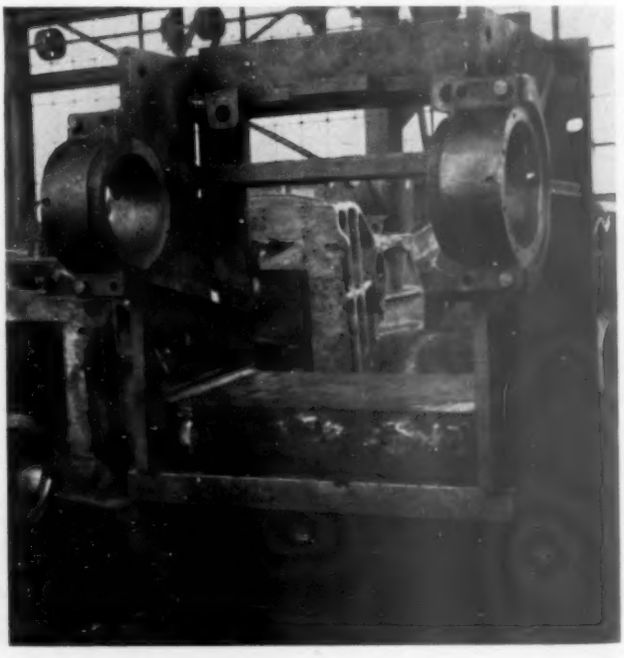


Fig. 2—Note trim lines of crusher base built by arc welding of flame-cut steel plates.

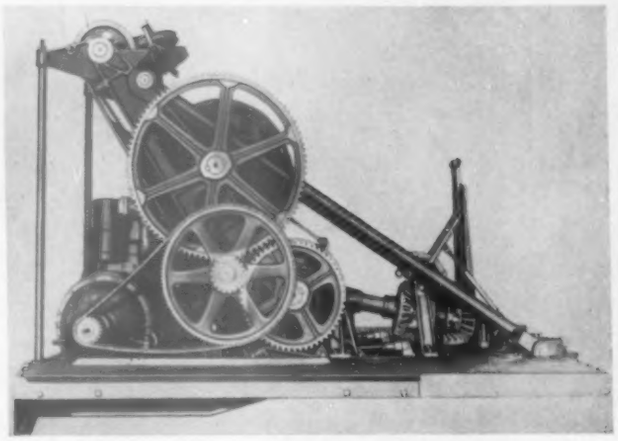


Fig. 1—A completely assembled turntable ready for mounting on the crawler. Photo (Lincoln Electric Co.—Thew Shovel Co.).

Redesign for arc welding of a

Power Shovel Turntable Bed

★ Part 1—Analysis of design problems which led to decision to replace cast unit with welded structure—Lower material costs and reduction of machining time

By R. H. ZEILMAN*

Assistant Chief Engineer, The Thew Shovel Co., Lorain, Ohio

ALL POWER SHOVELS, cranes and draglines consist of three basic elements—crawler base, turntable, and boom.

(1) The crawler base supports the weight of the entire unit and is the means of transporting the unit from one location to another.

(2) The turntable is mounted on the crawler base and revolves through a full circle.

(3) The boom equipment is fastened to the front end of the revolving turntable. This equipment may be a shovel boom, a crane, clamshell or dragline boom, a skimmer scoop boom, or a backdigger boom. Each is designed to produce the maximum efficiency on a particular class of excavating or material handling. In most modern excavators, all such types of boom equipment are convertible and interchangeable easily on any one unit.

A completely assembled turntable, ready for mounting on the crawler and the installation of boom equipment, is shown in Fig. 1. This turntable has two primary functions:

(1) OPERATION—The turntable supports, contains and holds in alignment the power plant (gasoline, diesel or electric) and all the necessary power shafts, gears, clutches, drums and operating levers and mechanism to permit the unit to perform the following operations, two or more of which may be performed simultaneously:

(a) *To swing,* in either direction, through 360 deg. of revolution.

(b) *To propel* the entire unit forward and backward.

(c) *To hoist* a bucket, dipper or load by means of a cable over the tip of the boom.

(d) *To crowd,* that is to push, out on the dipper stick of a shovel to give it a positive digging force in thrusting it into the material.

(e) *To retract,* that is to be able to pull back the dipper stick as necessary.

(f) *To raise and lower* the boom.

(g) *To drag-in,* or exert, by means of a cable, a direct pull-in on a dragline or backdigger bucket.

(2) LOAD TRANSFERENCE—Naturally each of the above operations results in certain stresses and strains which are transmitted into the turntable bed and are transferred through it into the crawler base. In addition there are other loads which must be transmitted into, and absorbed by, the turntable bed and are thus, in turn, passed into the crawler base and then to the ground. These other loads include:

(a) The thrust on the 4 rollers on which the turntable rests and on which supports it revolves.

*One of the Award Winners in the $200,000 Award Program of the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. This article presents the first section of this prize-winning paper, with only a few omissions.

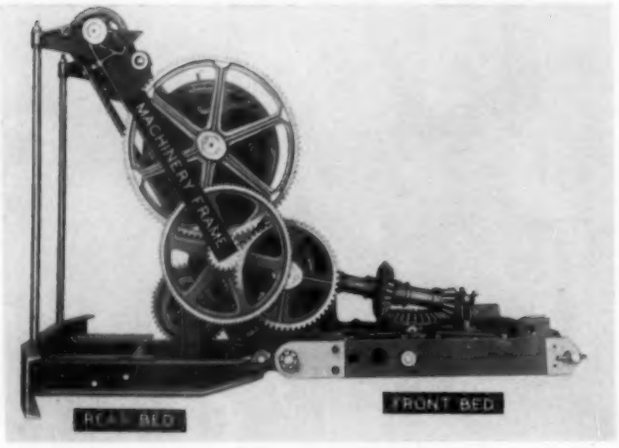


Fig. 2—The three basic elements of the turntable. Photo (Lincoln Electric Co.—Thew Shovel Co.).

(b) The up-pull on the center pin by means of which the turntable is anchored to the crawler base.

(c) The A-frame stresses which support the boom and its loads.

(d) The thrust of the boom foot at the front of the turntable bed.

(e) All warping and weaving effects due to the highly concentrated and off-center loads that may be developed.

Basic Turntable Structure

In view of these functions and loads, Lorain machines are built with a turntable design consisting of three parts: (1) A front turntable bed. (2) A sloping machinery frame. (3) A rear turntable bed.

These three basic elements of the turntable are shown in Fig. 2, in which the engine, front struts and operating levers and mechanism have been removed to show three basic elements plainly.

The front turntable bed is approximately the same length as the diameter of the rotating path, and revolves about a center at which point the center pin is located. All the turntable rollers, on which the entire turntable revolves, are located in the front bed: 2 at the front, 2 at the rear, thus giving a 4-point support.

At the rear of the front bed the sloping machinery frame is fastened by means of pin connections. All the power shafts and operating machinery are mounted in the sloping machinery frame. The front bed, plus the sloping machinery frame and the front compression struts (running from the top of the sloping machinery frame to the front of the front turntable bed) form the A-frame structure to support the boom.

Thus it is evident that practically all the operating and load transference functions of the turntable are concentrated in these elements.

Rear Turntable Bed

An analysis of the above items indicates that no provisions have been made for the following: (1) A support for the engine. (2) An anchor for the boom derricking drum and a dead-end for the boom supporting cable. (3) A means of locating any counterweight that may be necessary.

These three elements then are the primary functions of the rear turntable bed which is entirely independent of any of the other functions, loads, stresses and strains of the balance of the turntable. To further insure this isolation of functions, the rear bed is attached to the balance of the turntable at two points only, by hinge pin connections at the lower extremities of the sloping machinery frame. It is supported at the rear and held in a horizontal plane by two combination tension and compression struts fastened to the top of the sloping machinery frame.

While it may seem that the functions of the rear bed are comparatively simple, the matter of the weight it must support and its method of attachment to the front bed, present a design problem which can be understood only by explaining the operation of a shovel.

The design of an excavator resembles, to some degree, a balance scale in that the front end can lift in capacity only what the back end can hold down. Therefore, in order to take maximum advantage of the counter-balancing effect of the weight of the engine, and to utilize such other counterweight as may be necessary to attain maximum efficiency, these elements are placed as far to the back of the machine, and thus as far behind the tipping point, as possible. The total weight supported by the rear bed is approximately three tons, most of which is concentrated at the rear extremity of the rear bed which is approximately 8 ft. from the center of rotation.

The fundamental function of the shovel or crane is to dig or pick up a load at one point and raise it—next, to transfer it by swinging to a new position—next, to dump or lower the load. In actual operation this means the unit will swing back and forth through an arc of 45 deg. to 90 deg. on each operating cycle. In ordinary use a shovel will make 2 to 4 such cycles a minute, entailing 4 to 8 swings of the shovel. In each of these, the tremendous load at the rear of the rear bed must be swung. Thus it is clear that the design of the rear bed is not a simple job of designing for static or dead load factors, but one which must take into account a centrifugal load of considerable proportions.

Accurate Alignment

The centrifugal and inertia forces in swinging such a load present a big problem in design, because these loads develop tremendous strains on the rear bed, particularly at its connections to the front bed. Despite these loads, stresses and strains, these connections, as well as the entire rear bed, must maintain a constant and correct alignment with the front bed because:

(1) The transference of power from the motor (located on the rear bed) to the operating machinery (located on the front bed) is by means of a connecting multiple-roller chain.

(2) The means of supplying power to the boom derricking drum, to raise and lower the boom, is by means of a spur gear on this drum (located in the rear bed) which meshes with an idler located on the sloping machinery frame.

It was in redesigning the rear bed and in the substitution of a structural all-welded rear bed for a previously used steel casting that it was found that all these factors could be taken care of satisfactorily, while still realizing many advantages, both from an economical and operating viewpoint.

Previous Cast Design

Previous to July, 1937, the rear bed of a Lorain consisted of a horse-shoe or U-shaped casting approximately 5 ft. wide, 4 ft. 3 in. long, 5 in. deep. This casting was made of .20 per cent carbon steel and weighed approximately 570 lbs.

The shape of this casting, shown in

Fig. 3, was determined by the several functions it had to perform. In order that certain mechanisms, including the under pan of the engine, be accessible from the under side of the turntable, the center of the casting had to be left open in a "U" or horseshoe shape. The nature of the various parts it was required to support accounted for its bulk and irregularity.

Disadvantages of Casting

The bulk and shape of the casting was reflected in high foundry costs, because this 570-lb. casting required a 9,700-lb. flask. This practically limited us to one source of supply. Difficulty was experienced in eliminating warping and in later straightening the casting. Cracks in cooling also required welding on the casting. Thus the economy in material cost of a welded bed over a difficult casting was the first advantage considered in design of an all-welded structural steel rear bed.

The second opportunity for economy was offered in the machining operations, which on the casting were of considerable magnitude. In spite of all precautions of the foundry, there was sufficient warping in these castings to require extensive planing to get the level and correctly related surfaces required. It is evident that the weight and irregular shape of the casting made the handling of it difficult. Also the irregular shape made the proper clamping of the casting to the various machine tools (without distortion) somewhat of a problem.

Following is a description of the necessary machining steps on the casting. In the first place, accuracy and production speed required the investment in two jigs, one for the drill press, and one for the boring mill. The first machining operation consisted of a planer operation on 9 surfaces (see Fig. 3).

Secondly, the casting had to be mounted on a horizontal boring mill where two separate set-ups were necessary—one to bore 6 large holes for the front connections and the boom derricking drum pin. Next, a milling operation was necessary to get the proper spacing between the connecting lugs. Following this, a third set-up was necessary on the drill press to drill 25 holes in 3 different planes.

An additional and important production cost factor that had to be kept in mind in connection with such extensive machining operations, was the machining of each of these rear bed castings which utilized 8.5 hours of machine tool time on machines which were needed badly for other machining operations.

Such a problem, of course, could have been solved by the addition of more machine tools and the necessary housing facilities for them. Before considering such an investment, an analysis was made to see if a structural all-welded design would not result in freeing up these machines sufficiently to eliminate any such investment. This economy and reduction of plant investment is not considered in any cost comparisons, since our comparisons are based on the actual production cost of one type of rear bed versus the other. However, this item was one of the most important factors in arriving at the conclusion to redesign the rear bed.

Other Opportunities

It should be noted that in attempting to make the casting as economically and simple as possible, the anchor and the housing for the boom derricking drum pin and drum proper were cast in the same horizontal plane as the balance of the casting.

In actual field operation this was found to be a disadvantage because it dropped the outside flanges of the boom derricking drum so low they extended below the rear bed casting. This gave only 3 in. of clearance over the crawler treads as the machine revolved and while this was satisfactory it was not considered the best possible arrangement. It was also necessary to place a cast steel guard over the lower projection of the boom derricking drum gear, an item which called for the expense of an additional part and its installation.

It was determined that a redesign could be worked out which would present no difficulties in cost or fabrication in locating the boom derricking drum bracket in a vertical plane, instead of the horizontal position in the casting. Therefore, this drum could be raised sufficiently to eliminate the projection of the drum below the rear bed. This, of course, eliminated the need for a guard.

Summary

In view of the above items the following advantages were offered by a redesign:

1. Lower material costs.
2. Reduction of 8.5 hrs. of machining time.
3. Freeing up of machine tools for other uses.
4. A better location of boom derricking drum.
5. Reduction in weight over previously used casting.

(To be continued in the December, 1939, issue.)

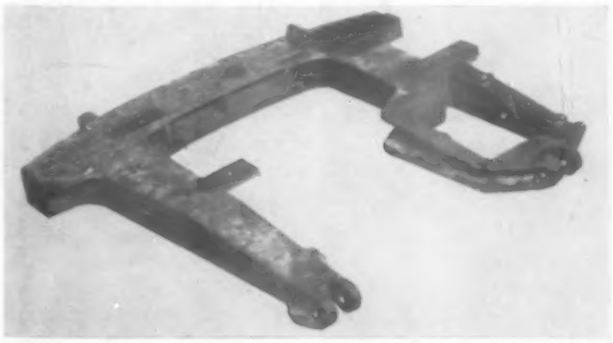


Fig. 3—The bulk and horseshoe shape of this casting resulted in high foundry costs. Photo (Lincoln Electric Co.—Thew Shovel Co.).

We'ding an expansion joint for a Swenson LTV Evaporator. Two operators are welding the girth seam, one inside and the other outside, on this 6 ft. 10 in. diameter joint. By using a manipulator, the welding is speeded up and welds of higher quality are produced. This piece of equipment will be used in concentrating waste black liquor from sulphate pulp mills. Shown watching the welders is L. S. McPhee, welding supervisor, Whiting Corp., Harvey, Ill. Photo (Whiting Corp., Harvey, Ill.).

Digests of
selected technical papers

Presented at A.W.S. Meeting

★ The widespread scope of the Society's technical program can be gleaned readily by reviewing these summaries of papers read at the recent annual convention

Effect of Alloying in Metallic Arc Welding

By R. W. EMERSON*

★ The author discusses some of the problems involved in the welding of low carbon and high-alloy steels, particularly from the standpoint of alloying produced when a portion of the kerf surface of the base metal is melted and alloyed with the metal deposited from the electrode. The discussion is based on results of an exhaustive investigation, in which a large number of welds were made and tested for tensile strength, hardness, soundness, and ductility. Data are presented on following topics: (1) welding of carbon and low-alloy steels with stainless steel electrodes; (2) welding of stainless steel with low-carbon steel electrodes; (3) welding of stainless steels and stainless irons with various stainless iron and steel electrodes. Photo-micrographs of these various types of welds are presented, and are explained on the basis of alloying effects.

*Westinghouse Electric & Mfg. Co.

Attention is called to one factor of primary concern from an alloying standpoint, namely, the ratio of the metal deposited to the parent metal melted. It is shown that this ratio increases as the welding speed is increased and as the welding current is decreased. The principal observations and conclusions presented in this paper are summarized as follows:

1. When metallic arc welding ferrous alloys, there are two factors which must be given consideration: (a) the effect of rapid heating and cooling on the parent metal as a result of the welding operation, and (b) the effect of alloying when the base metal is melted and alloyed with the deposited metal.

2. Low carbon and high-alloy stable austenitic steels are not affected adversely physically by welding heat and therefore the only consideration is that of the effect of alloying. This problem is not encountered if the electrode used for welding is of approximately the same commercial analysis as the steel being welded. The problem of alloying is only encountered in the welding of steels where an electrode of dissimilar analysis must be used and also in the case of the welding of dissimilar metals.

3. In cases where it is necessary to weld low carbon or low-alloy steel with austenitic electrodes, it is desirable to use an electrode in which the austenite is sufficiently stabilized so that after dilution with the low carbon or low-alloy steel it will still remain as stable austenite and not revert to martensite. The use of 25-12 or 25-20 chrome-nickel electrodes is believed to be preferable to 18-8 chrome-nickel electrodes for work of this nature.

4. A narrow band of martensite is not formed along the fusion line of a weld made with an austenitic electrode and a low carbon or low-alloy steel. Each layer of deposited weld metal is entirely austenitic or else the dilution is sufficient to cause reversion of the entire layer to martensite.

5. It is believed that, in general, any ferrous alloy in a stable austenitic state can be satisfactorily welded with an electrode of stable austenite such as the 18-8 or 25-12 variety of stainless steel.

6. Successful welds can be made on both 17 and 27% chrome iron with 18-8 or 25-12 stainless steel electrodes.

7. Plates of 25-12 stainless steel ¼ in. thick, when welded with 27% chrome electrodes produced an ultimate strength which was greater than

90,000 psi., failure occurring in the parent metal.

8. Twelve per cent chromium steel was successfully welded using both 18-8 stainless steel and also 4-6% chromium steel electrodes. Good physical properties were obtained.

9. The use of 17% chrome electrodes does not appear suitable for the welding of either 25-12 or 18-8 stainless steels.

» «

Weld Hardening of Carbon and of Alloy Steels

By H. J. FRENCH and T. N. ARMSTRONG*

★ In the early applications of metallic arc welding to alloy steels, cracking difficulties not infrequently were encountered. These were sometimes traced, in part, to the conditions of welding, involving such variables as speed of arc travel, size of electrode, types of rod castings, etc. But, also, it became apparent that some of the commercial alloy steels most widely used for heat-treated machinery parts were especially sensitive to variations of this sort and developed hard brittle areas adjacent to weld deposits, which reduced the toughness of the welded joints and often caused cracking during or after cooling.

From such early experiences, weld hardening has become well recognized by the welding industry as a factor of importance in the selection of steels, in establishing the details of processing, and in the utilization of these metals in welded structures. It is not to be assumed that absence of weld hardening is all that is needed to provide a satisfactory welding steel; on the other hand, however, a high weld hardening capacity means that the steel will be weldable only under restricted conditions.

As is well known, zones of high hardness in welded joints result from the chilling of the highly heated zones, in welding, by the adjacent colder metal areas. The time-temperature relations in both heating and cooling comprise what is essentially a heat treatment, and if the steel to be welded has a high hardening capacity and hardening tendencies, it may develop undesirable highly hardened zones adjacent to deposited metal.

In this investigation a study was made of a number of the variables that affect weld hardening, namely: (1) composition of the steel to be welded, (2) dimensions of base metal, (3) rate of arc travel, and (4) temperature of base metal. The method of study involved depositing a single bead on a steel plate, and then making a careful hardness survey over a cross section of the resulting weld. Plain carbon steels and alloy steels containing manganese, nickel, chromium and molybdenum were investigated, and quantitative data on the effect of each of the variables were obtained. The more important conclusions derived from this study are summarized below:

1. Weld hardness depends not only on the metallurgical characteristics of the steel being welded, but also upon many variables associated with the welding technique and upon the dimensions of the parts.

2. A low order of weld hardening under the broadest range of conditions can be secured only in steels with low carbon contents, since these are the only ones which have a low hardening capacity.

3. Under fixed conditions of welding, all of the alloy steels tested showed higher weld hardness than the plain carbon steels at equal carbon contents within the range 0.10 to 0.50% C. This may be ascribed to the greater hardening tendencies of the alloy steels.

4. When weight reductions are desired and steels of high elastic properties and strength are needed, low carbon, complex alloy steels offer distinct advantages over higher carbon, plain carbon steels with respect to weld hardening, and can have the added advantages of improved resistance to atmospheric corrosion, better retention of toughness at low temperatures, better creep resistance at high temperatures, etc.

» «

Brazing the Aluminum Alloys

By G. O. HOGLUND*

★ Although the aluminum brazing process is one of comparatively recent development, it has been applied successfully on several commercial applications, and has aroused considerable interest in those fields where the low cost of batch brazing can be applied to aluminum alloy parts on somewhat the same basis as is now done on other metals. The author discussed: (1) brazing methods; (2) cleaning of parts prior to brazing; (3) application of brazing material and flux; (4) details of brazing operation (furnace equipment, jigs for maintaining alignment, length of time required, etc.); (5) removal of flux after brazing; (6) mechanical properties and corrosion resistance of brazed joints; (7) effect of brazing on mechanical properties of parent metal.

Experience to date indicates that three brazing methods are practicable, namely, furnace brazing, dip brazing and torch brazing. On the first named, the parts are assembled, fluxed and brought to a temperature above the melting point of the filler metal, but below the melting point of the parent metal. Dip brazing is accomplished by assembling the parts in jigs to maintain proper mating of faying surfaces and applying brazing heat by dipping the assembly in molten flux, held at a temperature that will wet the surface of the parent parts and permit the filler material to flow into the joint. Torch brazing resembles very much the conventional gas welding process, except that a filler material of low melting point is used with a special brazing flux so that little or no melting occurs in the parent material.

Furnace equipment for brazing the aluminum alloys is essentially the same as that used for brazing other materials. The major difference is that the temperature range for brazing these alloys is lower than that used for ferrous materials. A temperature range from 1000 to 1200 deg. F. is used on all present applications that are now in production or being considered. All of the production brazing operations to date have been accomplished in an air atmosphere. Experimental work with the commonly used controlled atmosphere made by partial combustion of natural gas, coke oven gas, butane or propane, has not indicated that there is any advantage in using this type of atmospheric control. Good results, on the other hand, can be obtained with a pure hydrogen atmosphere, although it has not yet been necessary to use this gas in actual practice.

The alloys for which successful brazing processes have been developed include commercially pure aluminum (2S), an aluminum-manganese alloy (3S), an aluminum-manganese-magnesium alloy (4S), and an aluminum-silicon - magnesium - chromium alloy (61S). The strength of brazed joints in these alloys is about the same as the strength of torch welded joints. Pressure tests on some applications have

*Both of International Nickel Co.

*Aluminum Co. of America.

shown that the joints are sufficiently sound to handle at least 90 psi. air pressure. This can probably be exceeded considerably. Other tests with water have been carried up to 1700 psi. hydrostatic pressure without leaking. No difficulty from the standpoint of tightness is anticipated in brazed joints assuming the design of parts is adequate to carry the pressure.

It seems apparent that brazing processes should reduce the joining cost substantially. They provide neater joints requiring less finishing, and extend the range of welded joints to parts thinner than could heretofore be considered. The brazed joints produced as herein described have the characteristics of a welded, not a soldered, aluminum joint.

» «

Automatic Gas Welding of Oil Float Assemblies

By H. E. LERNER*

★ The author first discusses the principal problems of fabrication that have arisen in the past 15 years, and explains why welding has become the preferred method of fabricating these assemblies.

The material used in the float body is 28 gauge terne plate, held to a tolerance of plus or minus 0.003 in. In the first attempt at welding, the body with the lower cover assembled was revolved with one hand, while the welding was performed with a torch held in the other hand. Several units completed in this manner were able to withstand very rigid tests, from which it was believed that the operation could be performed automatically provided the proper assembly and controls could be worked out.

A special table was then built which would control the time of one revolution at any value between 15 and 120 sec. Experiments with a preheating torch and a 15 sec. cycle showed that the preheating torch was a disadvantage rather than an advantage. Tests were therefore conducted with only the single torch, and cycles varying in length from 40 to 120 sec. were investigated. It was found that an 80 sec. cycle produced the most uniform welds.

Applying this process to a production machine introduced problems of mounting, speed control, adjustment of torches, etc. These problems involved mechanical details which were satisfactorily worked out. One serious difficulty was encountered, however, in the matter of holding the two parts in proper relationship and eliminating creep. This problem was overcome by building new dies to control the flange portions, and assembling in a press to achieve an interlocking action.

The production welding machine finally developed was an eight-station unit, operated on an 80 sec. cycle, and handled by one operator. The basic schedule for each machine with one operator is approximately 1500 finished units in 8 hours. The cost of table, fixtures, etc., for the eight-station layout is approximately $750, and the welding cost for the finished units is 72 cents per 100 pieces.

*Taylor Sales Engineering Co.

» «

Shrinking of Steel to Correct Distortion

By SAMUEL T. SMETTERS*

★ In this paper the author describes a method of correcting distortion resulting from welding, by heating and cooling certain parts of the distorted or warped structure in such manner as to produce controlled localized shrinking, thereby bringing the structure back into its intended shape. The general principles involved in this practice are discussed, and four typical applications of the process are described in detail.

When steel is welded or forged, contraction takes place in the locations of welding or forging, which may result in locked-up stresses or distortion. The magnitude of shrinkage depends on numerous factors, including the temperature to which the steel is heated, the rate of heating, the thermal expansion and contraction characteristics of the steel, the thermal conductivity of the steel, and the rate of cooling. If the heat is dispersed gradually throughout the entire section of a steel structure, then the shrinkage will be uniform and distortion will be avoided. Thus the distortion from welding is lessened if the weld is protected from drafts and sudden cooling, allowing the heat to dissipate slowly throughout the entire mass. Similarly, in heating for shrinkage, which has the opposite purpose, the section to be affected should be heated quickly and then cooled rapidly either with water, compressed air, or some other cooling medium.

*Engineer, Sanitary District of Chicago.

In applying the shrinkage process to steel structures, heat is applied until the temperature reaches 900 to 1100 deg. F. Higher temperatures are avoided in order not to change the grain structure of the steel. The rate of heating, or the duration of maintaining the heat, do not seem to make a great deal of difference, but rapid cooling produces the greatest shrinkage. Quite frequently the heating and cooling process produces effects that were not anticipated, but which may be explained by the presence of locked-up stresses in the structure. Any steel section having locked-up stresses will react when heated to relieve the stresses as well as to shrink. Beams, plates and other rolled sections frequently contain locked-up stresses resulting from the rolling and straightening operations in their fabrication.

The author describes in detail three examples in which structures badly distorted in welding and hot forming were brought back into shape by means of this process. These structures were: (1) a head gate, which after welding was badly dished concave on the plate side; (2) a beam, one flange of which had been hot formed to a 1 ft. 6 in. radius, and which became badly bowed when cooled; (3) a pair of special girder beams fabricated with continuous fillet welds, which were bowed and warped after welding. A fourth example is presented to illustrate how the shrinkage can be applied at the same time as the welding, in order to prevent distortion.

» «

Flame-Descaling, Flame-Cleaning and Dehydrating

By J. G. MAGRATH*

★ Gradual recognition that thermal scaling of ferrous metals is a cause of both manufacturing and surface treatment difficulties has resulted in rapidly spreading interest in means for swift removal of surface accumulation of this kind. The presence of scale on steel billets in the steel mill prevents close inspection for the locating of minute defects and fine seams prior to flame scarfing or chipping. On structural steel, the loosening and flaking off of mill scale, taking the paint with it, leaves the steel fully exposed to atmospheric oxidation and provides an opportunity for moisture to find its way between the remaining scale and steel. Frequently heavy or hard scale

*With Air Reduction Sales Co.

on forgings and steel castings is damaging to cutting tools in the first machining cut and sometimes conceals defects that may later cause failure. In this paper the author describes applications of the oxy-acetylene flame to descaling and flame-cleaning and dehydrating processes.

In flame-descaling billets, bar-stock, blooms and ingots in the steel mill, the process employs use of the oxy-acetylene torch in combination with brush-type tips, on extensions, which are positioned so that the enveloping flame completely covers the scaled surface for the width or expanse of the tip flames. These tips are mounted on wheeled carriages or hard-faced skids and are traversed over the surface at the proper rate of speed to remove maximum amount of scale. By means of high temperature thus applied the scale is rapidly heated, without overheating the base metal, producing a differential expansion which causes scale to lift, crack and fly off in small particles. Flame-descaling, which serves satisfactorily for the greater volume of common grades of carbon and low-alloy steels, leaves a natural surface. Artificial resurfacing found in various other scale removing procedures is absent, and there is no chemical or physical action upon, or discoloring of, the base metal. The process is equally applicable in the steel foundry or forge shop.

The oxy-acetylene flame-cleaning and dehydration process is new, and at present is being subjected to practical tests under normal conditions on erected steel bridge structures in the East. The process is intended for application just prior to painting, and is designed to remove surface impurities other than oil and grease, which are removed beforehand with mineral spirits, benzine or gasoline (degreasing). Flat tips mounted on renewable steel hard-faced wearing skids, provide a row of close formation small brush-like flames which are guided across the surface at a forward speed of 10 to 20 ft. per min., and at a flame impingement angle of approximately 45 deg. Round tips having hard-faced annular wearing rings are used for cleaning of rivet heads, fittings, faying surfaces, corners and other projections inaccessible to the broad flat tips. As the flames progress along the surface, a variable amount of mill scale is loosened and cracked off. A further amount is partially loosened to such degree, that it is easily broken free by the light wire-brushing which immediately follows. That scale which will not lift either with the flame or the wire-brushing that follows, is passed on inspection because it is definitely tight scale which there is no point in removing, provided moisture is driven therefrom. The process has been similarly applied for the paint-burning and surface-conditioning of old painted steel structures.

» «

Designing Construction Machinery for Production

By H. C. HETTELSATER*

★ The topics covered include: (a) advantages of welded construction, with particular reference to excavating machinery; (b) properties of various classes of structural steels; (c) factors governing selection of steels and welding electrodes; (d) examples of redesigning to take advantage of benefits to be derived from welded construction. The latter topic is covered by detailed descriptions of such structures as shovel booms, box-section beams, dragline and crane booms, car body frames, and revolving excavator frames. The author concludes his paper by stating some of the problems peculiar to welded fabrication, and indicating how they may be taken care of by proper designing. The more important of these principles are summarized in following paragraphs.

Consideration must be given to the assembly of the welded part to be certain that all welds are made accessible and that they can be positioned so that sound weld metal will be deposited. Wherever possible the design should be such that beads can be laid in a downhand position.

Lap joints should be avoided if possible since they usually result in eccentric loading on the weld and also result in excess metal being used which is of no value in producing greater strength. In this connection it has been found to be good practice to utilize bent plate construction wherever possible since this results in greatest economy of material and also reduces amount of weld metal which must be deposited.

Rolled structural shapes also possess many advantages and it has been found that they lend themselves very well to welded construction, especially where the shape of the part is such that the welded connection can be made to the toe or flange of the section, and overlapping of metals can be avoided. In such case it is necessary, of course, that the part be so designed that the weld metal will fully develop the strength of the main section, and if alloy steel is used, the welding electrode which is selected must produce a weld which has physical properties equal to those of the parent metal.

Frequently the designer, when faced with a problem of designing a structure for welding, has a fixed picture in his mind of that same structure which has previously been produced by the use of castings or riveted construction. As a result he is prone to design the welded part similar in shape and general characteristics to the part previously used. Usually he has not achieved the best results from an economical standpoint if this is done, and it will be found that his design will involve too many compromises to be an economic success. To overcome this tendency the designer must think not only of the design of a particular joint in a structure, but must consider the structure as a whole and work out a method for producing the complete machine or framework which will be the most economical to produce as a welded structure, without regard to any preconceived notions as to what the machine should look like.

*With Harnischfeger Corp.

» «

Fabrication of Large Welded Equipment

By LESLIE S. McPHEE*

★ If welding, eventually, is to reach its expected level, something must be done to acquaint all designers and engineers with the potentialities and requirements of this "science of welding." As we scrutinize the detail drawings of many of our industries there is no doubt left in our minds that the practical welder has advanced beyond the designer with regard to his share of the problem. Too often the design is made with a riveted structure in mind, then the rivet size and spacing is omitted, a note is added "weld throughout," and this is called a welded design. When this is called to the attention of the draftsman, the answer is usually, "Well, the welding supervisor knows more about the strength of his welds than I do," which is probably true, but this is a deplor-

*Welding Superintendent, Whiting Corp., Harvey, Ill.

able condition. Although the welding supervisor usually does know the strength of the welds, he should not be expected to know the magnitude of the stresses developed or the theory of their application. Therefore it is imperative that all information relative to welding be on the drawing, even to the smallest detail.

The two main factors in a quality welded structure, whether large or small, are design and material. It is regretted that some people are more interested in quantity than in quality, and quality is one word that must be kept in mind as there is no other to replace it. For quality, where welding is concerned, the best is not good enough, whether it be base material, welding rod, welding machine or operator. The cost of the weld, or of the material going into it should be of secondary importance. Quality does not mean that all welds should be of fired pressure vessel standards, because by economic necessity more than one class of welding is required. But poor welds in all classes can generally be traced to poor materials, design and equipment, quite as often as to poor workmanship.

We find that the preparation of the material rates next to design in the consideration of economy, distortion or locked up stresses, and last but not least, the morale of the welding operator. When preparing the joints in materials under ¾ in. thick, it is doubtlessly more economical to use the plate planer for this purpose as a closer control can be held over the contour and tolerance of the bevel or groove. However, on materials over ¾ in. thick, economy practically forces the use of the bevelling torch for this operation.

The next item in sequence and importance is the set-up assembly and tack welding. We find for this operation that personnel again plays a major part and that the most satisfactory person for this operation is not merely a structural assemblyman, but an experienced welder with ability to read drawings. This is true because of the fact that a welder is fully cognizant of what a poor fit will mean in the final cost. He also has a working knowledge of distortion and can generally predict which way and about how much the parts will shrink. He realizes the disadvantages of tacks that are too large and just how small they can be and still be expected to hold. After the parts have been assembled and tacked, the next thought is to get them into the most economical as well as the most convenient position for welding, which is naturally the flat or down-hand position and which necessitates positioning equipment, manipulators, tank rolls, cranes, hoists, adjustable scaffolding, etc. This equipment pays the highest form of dividends relative to cost reduction, stress distribution, appearance and a partial elimination of the human element.

» «

Use of Steel Castings in Welded Fabrication

By H. J. SHIFFLI and EMIL KREJCI*

★ Specific examples are presented to illustrate how castings, plate, forgings, and special rolled shapes may be used in combination to produce the best design at a minimum cost. It is pointed out that much loss has resulted from using all-welded designs for structures in which castings or some of these other forms of steel might better have been used.

When certain conditions are present, the designer would do well to consider using a steel casting for part of a fabricated structure. If, for example, a structure contains an intricate part which does not lend itself to simplification by the use of standard shapes and forms, then a steel casting would probably be the best and most economical solution. Similarly, the following conditions might suggest the use of castings, (1) when numerous parts of a given design are required, (2) when the physical dimensions of a certain section are compact to the extent that the welding operation cannot be performed satisfactorily, (3) when a great many separate pieces are involved, and the amount of welding necessary results in an excessive labor cost, (4) when the quantity required does not justify the expense of making dies to form special shapes, and (5) when a structure requires the use of steel of a special composition or alloy in certain of its parts.

The question of whether to use steel castings in a given fabricated structure must be considered on the basis of cost and good judgment. Patterns are a necessary part of the equipment for producing steel castings, and when castings are made in very limited quantities the pattern charge adds materially to their cost. But when the pattern charge is spread over a large number of such castings, it becomes greatly reduced, and is considered eventually to be absorbed. Welded jobs require jigs and fixtures of more or less elaboration according to the nature of the work. Sometimes these jigs and fixtures become a very expensive item compared to which the pattern cost incident to steel castings is of less importance than frequently supposed.

Some comment should perhaps be made on the weldability of steel castings. Our experience has indicated that steel in its cast form is as readily weldable as any other form of steel. The material in the usual steel casting of .25 to .30 carbon can be welded with the regular coated electrode without special preparation. Castings of a special composition can be readily and reliably welded by using the proper electrodes and technique. The fact that steel is designated as weldable does not mean that welding technique and procedure, preheating when necessary, subsequent heat treatment and any other necessary preparation can be dispensed with. All these are details entering into the accomplishment of a successful welding job.

*Both of American Steel Foundries

» «

Welding in a Steel Mill

By R. P. PALMER*

★ This paper discusses the advantages particularly with respect to cost reductions, which can be realized by steel mills through full utilization of welding. The author illustrates the contrast between a mill that makes adequate use of welding and one that does not, and then describes in detail the organization of the welding department in a steel mill that employs welding extensively. The topics considered include: (1) suitable location and equipment for the welding shop; (2) weld designing; (3) selection and training of welders; (4) system of organization and cost recording; (5) savings secured by use of welding; (6) need for welding department to "sell" welding to all departments of the mill.

Work in a steel mill usually originates with the department master mechanic. After the necessary approval has been obtained, the engineering department starts work on the design. Weld designing in the steel mill is more difficult than in the production shop, since almost every job requires individual designing. Regardless of

*Wheeling Steel Corp.

the experience the designer has had with welding, it is best that the welding foreman check the drawings as the work of designing progresses. When the job and prints are received, the welder who is to be assigned the job is called in and the plans are gone over carefully.

The man who does the laying out also fits up the job and is responsible for putting the job together ready to weld. Each welder working on a job stamps his check number at the start and stop of his weld and understands very distinctly that he is responsible for the work he does. This helps to maintain a high standard of workmanship. In some cases coupons are cut and tested, but in most of our work this is not practical. For our particular kind of work, the best method of inspection is visual examination during and after welding. Each welder is required to make test welds every 60 days.

It is of paramount importance that welders be selected who are reliable, conscientious and dependable. We use the apprenticeship system for training our welders, requirements being high school education, physical fitness, residence in the immediate community, and to have worked in the general labor departments for a sufficient period for them to have learned what hard labor really is. Our welding course has been copied from courses used by several of the leading welding equipment manufacturers to train welders. After a practice period the apprentice is assigned to tacking with the layer-out and as he progresses he is advanced until he has worked in all departments on all classes of work. Steel mill work usually requires about two years' training.

It is very important for the welding department to "sell" its services to the other departments of the mill. A lot of selling is required to keep a welding department of this type busy and progressive, in fact, every man in the department must be a part-time salesman. For example, a welder was repairing a cast-iron door frame in one department and mentioned to the millwright that he had made welded steel door frames for a furnace in another department and explained some of the changes and improvements that had been made on the new frames. The millwright told the department master mechanic, who immediately investigated and found this new door frame to be just what he wanted.

Maintenance of Way Welding

By C. E. MORGAN*

★ The topics considered include rail welding, the construction, repair and reinforcement of bridges, the use of welding in building construction, and the application of welding to equipment used in maintenance of way.

The largest field for welding in railroad work has been the building up of battered rail ends. This work started at about the time of the last World War, and has increased steadily in volume ever since. The oxy-acetylene method was used almost exclusively at first, but in recent years many railroads have also adopted the electric arc method. The present tendency is to use a material, which when deposited will have a hardness of 350 or even 400 Brinell, thereby achieving better wearing qualities and still maintaining ductility at least equal to that of a rail in its "as rolled" condition.

Surface grinding and cross grinding (to provide an opening for any flow which occurs and thus prevent chipping) are employed for finishing up the work. Other track uses of welding are the repair of frogs and crossings, and elimination of rail joints to form long continuous rails. The latter is accomplished by the thermit, oxy-acetylene, or resistance welding processes, or by pressure welding.

Bridges are now being designed which require a considerable amount of welding in fabrication of members. Weight savings of from 12 to 15%—and in some cases as high as 17%—have been recorded, and it is probable that more welded designs will appear as maintenance charges on the ones now in service are made available. At present there is a rather large field for welding in the repair and reinforcement of bridges. Many bridges are now being subjected to much heavier loads than formerly, because of much heavier engines that have recently come into use.

The use of welding in building construction has been increasing steadily, in part because buildings of all types are now being designed with steel skeletons. One advantage of welding over riveting is that it permits alterations in design to be made after construction has been started, without the necessity for drilling or punching additional holes. For making alterations and additions to existing structures, welding is preferred because it does not entail cracked plaster, scattered dust, or objectionable vibration and noise.

Very little need be said about the application of welding to equipment used in maintenance of way, as it is a matter of common knowledge that welding is used extensively in the maintenance of such units as motor cars, draglines, shovels, ditchers, ballast machinery, adzers, spike pullers, bolt machines, and the like.

*With Chicago, Milwaukee, St. Paul & Pacific R.R.

» «

Repairs to Steel Castings

By S. D. BAUMER*

★ This paper discusses the savings in time and expense that the steel mills have realized through the use of welding and flame cutting for maintenance purposes. Typical examples are cited of repairs made with the thermit, electric arc, and oxy-acetylene welding processes.

As an example of the thermit process, the author describes in detail the thermit welding of a broken bending roll 36 in. in diameter and 40 ft. long. This particular job was accomplished in two weeks total time, whereas a new roll would have required at least two or three months for delivery and would have cost approximately four times as much.

The wide use of arc welding, especially for building up worn parts, is mentioned briefly, and two examples of casting repairs are described in detail. The first was a large 40 in. blooming mill roll housing casting, which had cracked through from the bearing seat to the bottom web of the casting. To avoid the expense of removing the housing from the mill, the casting was repaired in place. A 1½ in. hole was drilled at both ends of the crack to prevent further progress, and the broken portion was then veed out with the cutting torch, ground, and chipped to make sure all broken metal, scale and dirt was removed. After preheating to about 400 deg. F., the welding was started from the bottom upward, the weld being in a vertical position. Each successive layer of weld metal was cleaned and lightly peened to insure as solid a deposit as possible. After the main weld itself was completed, two braces from the bearing seat to the bottom web were welded in diagonally for additional strength. The

*Bethlehem Steel Co.

complete job required only 48 hours time.

The other example of electric arc welding was the repair of a 3½% nickel steel casting used as a cylinder in a wheel press and subjected to 12,000 lbs. pressure. This casting had shown signs of leakage and was found to be cracked its entire length. Inasmuch as the wall thickness was 11½ in., the member was placed on a large slotter and a "U" cut from either side to form a double U groove. The casting was then welded in the same manner as described in the previous example, except that annealing was performed both before and after the welding operation. The cost of this repair was $3,000, whereas a new casting would have cost $12,000 and would have required many months for delivery.

» «

Welded Nozzles and Their Reinforcement

By F. C. FANTZ and W. G. HOOPER*

★ This paper presents a simplified method for determining the necessity of nozzle reinforcing, and also the amount and type of reinforcement required, in order to comply with Paragraph U-59 of the A.S.M.E. Code for Unfired Pressure Vessels, as it applies to the pipe fabrication industry.

The advancement in the art of welding in the last decade, both in quality of welding procedure and proficiency of welding operator, have convinced the piping designer that the application of welding in the design of piping systems is entirely practicable. This confidence in welding is evidenced by the almost complete elimination of cast flanged headers, tees, elbows and flanged joints, and the substitution of welded headers, welding fittings and butt welds in the modern piping design.

The various A.S.A. Codes have established definite rules governing the design of piping systems, with formulas developed for ascertaining the wall thickness of pipe and welding fittings and the strength of butt and fillet welds. However, there is nothing in any of the A.S.A. Codes that can be applied to the design of nozzles attached to headers or piping, that would determine when reinforcement might be necessary to compensate for weakening of the header due to removal of metal for nozzle opening.

The A.S.M.E. Code for Unfired Pressure Vessels applies primarily to the materials, design and manufacture of pressure vessels such as tanks, separators, receivers, etc., but is not intended to apply 100% to fabrication of piping materials. However, this Code does cover the design of welded nozzles attached to unfired pressure vessels, and since it is the recognized Code with formulas governing the attachment of nozzles and reinforcement of same when necessary, it is logical that the piping designer accept these rules and be governed in his design by Paragraph U-59 of the Code for Unfired Pressure Vessels, revised August 15, 1938. This section of the code covers design of nozzle openings, and a nozzle attached in compliance with rules and conditions of Par. U-59 is entitled to bear the A.S.M.E. stamp as conforming to the Code, and as being within good limits of safety.

This section is extremely simple and clear to the boiler designer, who is using it constantly, but to the piping designer it may seem complex and the rules governing the design appear cumbersome. With the idea in view of making this section applicable to the piping industry for the design and fabrication of welded nozzles attached to headers and pipe, the authors have clarified the various rules and have set them up in the form of simple algebraic equations, with graphs for determining the several constants used. This method applies only to headers of sizes from 6.625 in. O.D. to 24 in. O.D. inclusive.

*Midwest Piping & Supply Co., Inc.

» «

Weld Inspection by Means of Trepanned Plugs

By W. T. TIFFIN*

★ In this paper the author discusses the method of inspecting welds by means of trepanned plugs. The recent adoption of this inspection method in certain welding codes is mentioned, and a detailed description is given of how the trepanned sample is obtained, prepared, etched and inspected. The author then describes the methods of closing or repairing the hole left by removal of the trepanned plug, and presents the results of a number of tests of several methods of closure.

Trepanning may be defined as a mechanical process for removing plugs from a parent base. The tool used, called a trepan, is a circular metal saw with a pilot in the center. The pilot may be either a straight shank drill or it may be some type of pilot bar. The trepan should be of a size sufficient to include the entire weld seam and enough of the adjacent parent metal as to allow some conclusions regarding the degree of fusion obtained. An electric drill, a pneumatic motor, or, in some cases, a drill press may be used to drive the trepan.

The A.P.I. adopted the trepanning method, for use in construction of all-welded oil storage tanks, in November, 1938; and a similar procedure appeared as a proposed addition to the A.S.M.E. code in the May, 1939 issue of Mechanical Engineering. The A.P.I. code requires at least one plug from each hundred feet of joint and the proposed addition to the A.S.M.E. code requires one specimen from each fifty feet or fraction thereof. One specimen should be taken from each section of a vertical joint where a vessel is built up of several courses. Good practice should require the selection of one specimen from each operator's work regardless of the length of seam. Where such selection is practiced, the trepanned plug becomes a permanent record of the actual condition of the weld seam at that particular point. Random selection of plugs has the same value to the inspector as the "sample grabbing" of fuels or chemicals has to the analyst. Moreover, it would not be sound reasoning to assume that the weld seam could be seriously defective and not have the same degree of unsoundness exist throughout its entire length.

The trepanned plug is usually polished to a bright, smooth finish before it is etched. A very satisfactory etching reagent is a 50% solution of hydrochloric acid used at a temperature of 160 deg. F. At this temperature the solution is active with negligible change in concentration due to evaporation. The principal defects to be looked for in the etched plugs (as noted in both the A.P.I. and A.S.M.E. codes) are lack of fusion, slag inclusions, gas pockets, cracks, and undercutting. If the weld proves to be only slightly defective when checked against code requirements, another specimen may be trepanned and subjected to the same testing procedure. If the second specimen is satisfactory, the weld is acceptable.

The author illustrates twelve different methods for filling or repairing the hole left by removal of a trepanned plug, and presents test data for ten of

*University of Oklahoma.

these methods. The tests covered plate thicknesses of ¼, ⅜, ½, ¾ and 1 in.

» «

Cold Rolling Testing of Welded Steel Specimens

By R. L. DOWDELL and T. P. HUGHES*

★ This paper describes a method of testing welds by observing the effect of cold rolling on the welded joint. The authors state that the usual tests (tensile, free bend, nick-break, etc.) are rather easily met by competent welders, and that there is need for a more drastic, more destructive test which can be carried out in the field and which will measure qualitatively any internal or locked-up stress in the vicinity of the weld. The proposed test method is based on the principle that if there are high internal stresses associated with a weld, external stresses such as those produced by cold rolling should cause rupture in a relatively short time.

The test specimen is a strip 1½ in. wide cut from butt welded plate of any thickness up to 1½ in., the specimen being taken from the plate in such a way that its longitudinal dimension is transverse to the direction of welding, and the weld itself is located midway between the ends. The weld reinforcement is ground flush with the surface of the plate on both sides. The specimen is tested by passing it cold through a set of flat two-high rolls of hardened steel 3 in. in diameter by 5 in. long, reducing it .010 in. per pass until the specimen either fails (evidenced by a transverse crack) or is reduced to strip .010 in. thick. Although cold rolling of welds is not new, its application as a test method has not, to the authors' knowledge, been previously reported.

The authors discuss the results of approximately 100 tests on ¼, ⅜, and ½ in. plate of 0.20-carbon open hearth steel and S.A.E. 1045 steel, butt welded by the electric arc process with heavily-coated electrodes. In nearly all cases, the ¼ in. plate of both grades could be reduced to 0.10 in. strip in about 25 passes without evidence of rupture along the weld or at the bottom of the vee. About two-thirds of the welds in the ⅜ in. and ½ in. plate (both grades) would fail at the root of the vee after only 4 or 5 passes. Microscopic examination revealed that these failures were caused by insufficient penetration at the root. The welds, however, were relatively clean and showed a rather sharp line of demarcation between weld metal and base plate.

The authors claim that this test has the following advantages over the usual tensile and bend tests: (1) It reveals insufficient penetration with heavy stock better than other tests. (2) It is cheaper because special test bars are not required. Any flat piece of nearly any width or length can be used as long as rolling is transverse to the direction of welding. (3) It is faster and the rolling tends to concentrate stress at the weld which after all is the portion of the plate to be tested. (4) It shows the general plasticity of the weld together with the adjoining base metal. (5) It is a more satisfactory test to convince a welder of any faulty welding and help him improve his technique.

*Both of University of Minnesota.

» «

High Spots of Ship Welding

By E. D. DEBES*

★ The author describes welding operations carried out in a large shipbuilding plant. Topics covered include scope of operations, design, material control, equipment, and welding process organization. It is not generally appreciated that a large shipyard carries out welding operations of almost all types and on a great variety of metals. For a 35,000 ton battleship such as Bethlehem is now constructing, for example, welding is used for fabricating units of all sizes, from 250-ton gun turret units to cold-rolled steel 0.020 in. thick. This vessel will be about 70% welded, and 1,500,000 lbs. of welding electrodes will be used to lay down 4,500,000 linear feet of welding.

Design is one of the most important high spots in ship welding, as the welding cannot be carried out successfully unless the work in the drafting room is performed with a full understanding of the facilities in the plant and the conditions under which work has to be done. Great progress has been accomplished in the Bethlehem plant along this line due to close cooperation between technical staff and production personnel. As an example of this type of progress, changes have taken place in rudder design since construction of the first all-welded rudder.

The welding machines used in this shipyard are mostly of the constant potential d-c. reversed-polarity type, of 1000 and 1500-amp. capacity. Outlets are available for 315 welders on one shift. Thirty single-operator machines are used for backing up the constant-potential machines, and in cases where straight polarity or high amperage is to be used. The welders use helmets almost exclusively, hand-shields being used only in tight places and on certain special work. The electrode holders are of the screw type, and are completely insulated so that when there is no electrode in the holder it is dead. Positioning tables are built where necessary to suit special jobs. Much attention is being given to increasing the welding space and providing heavier equipment in order to increase sub-assembly welding.

Every sequence in both ship and shop welding is carefully controlled in three ways: (1) by close cooperation with the drafting room, (2) by general procedure write-up, and (3) by detail sequence procedure schedules. The personnel of the welding department includes inspectors whose duty it is to inspect work which is reported ready for welding, and whose approval is required before any welding is started. A considerable decrease in cost of both welding and shipfitting has resulted since this inspection was put into effect. It used to be the opinion that "this is a welded job and we do not have to be fussy," whereas better fitting is required for welded work than for riveted construction. The saving in shipfitting is due to the fact that much less refitting is done, as more care is now taken to pass inspection.

*Bethlehem Steel Co.

» «

Repairing a broken cast-iron door frame on a boiler by means of arc welding. Photo (Westinghouse Electric & Mfg. Co.).

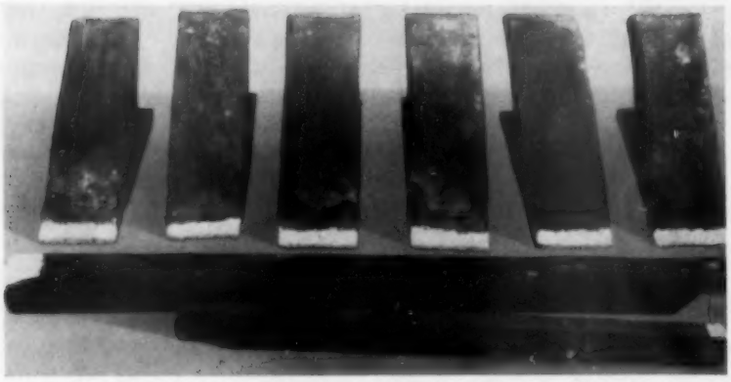


Fig. 1—Hard-faced extension tips on regular dipper bucket teeth increase the tooth life from 2 to 4 times. Photo (Haynes Stellite Co.).

Hard-Facing Effects Economies On Earth-Moving Equipment

★ Hard, wear-resistant alloys, welded on to surfaces undergoing extreme abrasion, have proved to be particularly economical when applied to wearing parts of earth-moving machinery. Not only are equipment maintenance costs reduced by application of such hard-facing metals, but equipment operates more efficiently. Sharper cutting edges, with resultant power savings, quick and inexpensive reclamation of worn parts, and fewer shutdowns and replacements—all these result in faster work at less cost.

When a scraping type of abrasion is encountered, but, at the same time, little or no shock occurs, there is a condition requiring attention from a standpoint not often considered. Under such circumstances, which may be typified by a set of dipper teeth handling fine sand, there is so little shock that the blows are not sufficient to obtain the full efficiency from teeth made of a work-hardening steel. Work-hardening metals do not attain their most wear-resistant condition until they have undergone impact under working conditions. For this reason, they may wear more rapidly when handling loose sand than when moving a cut of shale or rocky material. In order to overcome wear under conditions of little or no impact, the most reasonable and effective method is to hard-face the bucket teeth with a metal which is originally and inherently hard and wear-resistant, such as the cobalt-base hard-facing alloys.

The large proportion of hard-facing applications in the excavating industry, however, require a material extremely tough and impact-resistant as well as wear-resistant.

With the increased use and popularity of hard-facing with work-hardening iron alloys, a few suggestions with regard to the application procedure for this material may be of interest. These rods can be applied by either the oxy-acetylene or arc welding process. Although initially harder deposits can be obtained with the oxy-acetylene torch,

Fig. 2—The life of tractor treads is materially lengthened by hard-facing. Photo (Haynes Stellite Co.).

most of the material is applied electrically, since the deposited metal readily work-hardens. For applying it to manganese steel castings, such as dipper bucket fronts, bucket teeth of all types, and jaw type crusher plates, the electric arc process is recommended. On parts other than manganese steel, however, either process can be used.

One of the most common applications of hard-facing materials is for dipper teeth on steam or electric shovels. When a ferrous hard-facing alloy is to be applied, the electric arc process is usually used. Using a 3/16-in. diameter rod, the first application should completely cover the worn end before the actual building-up process is begun. After the first covering is completed, a ¼-in. diameter rod may

Fig. 3—A close-up of hard-faced dipper tooth which lasted 6 times as long as an ordinary one. Photo (Haynes Stellite Co.).

be used to speed up the process. The temperature should be kept as low as possible. Working on two or three teeth at one time will assist in maintaining a low temperature. Each tooth should thus be built-up on a taper to conform to the shape of the original teeth and often three sides of each tooth are covered back about 6 in., leaving the top side free to wear and give a self-sharpening action. A bead should also be run on the tooth tips to fill in the ragged edges.

On those teeth which are to be subjected to such hard usage that it is felt that breakage might occur, a cloth or

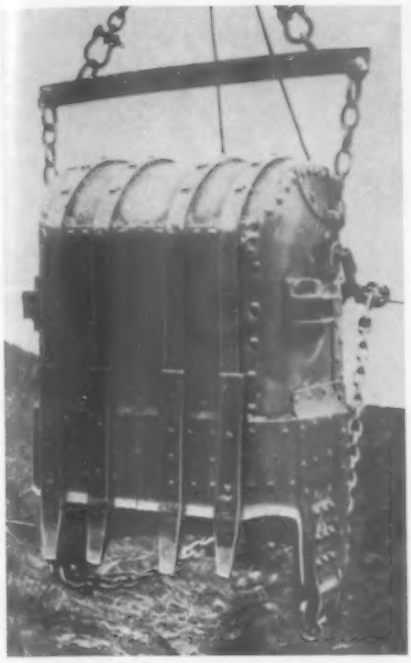


Fig. 4—Hard-faced lip of this bucket is still good after handling 600,000 cu. yds. of gravel, clay and broken concrete.

rag well soaked in water should be avilable and occasionally applied to the built-up section during the welding process. Cooling will improve the toughness of the layer of hard-facing metal. After a tooth has been built-up approximately to shape with the weld metal running crosswise, the final covering or finishing beads should be laid running lengthwise. This eliminates cross creases and lines or strings and gives a tougher deposit. Dipper teeth hard-faced with ferrous alloy in the manner described last two or three times longer than unprotected teeth. Chromium-nickel and chromium-molybdenum steel dipper teeth can also be hard-faced by the same procedure.

The arc welding process is quite satisfactory for repairing or building-up cracks or breaks in shovel bucket fronts. Where the crack or break extends in from either the lip or door edge, the portion which remains intact must be preheated before welding is started. This is done to expand the unbroken section extending from the inside end of the break to the other edge, in order that the weld will have an opportunity to contract without breaking. Preheating should be done over a wood or charcoal fire with the portion of the bucket to be welded elevated about 2 ft. above the hottest part of the fire. Sufficient protection, of course, must be given the welding operator from the heat of the fire. This can be accomplished by means of asbestos paper, scrap sheet iron, or whatever material may be available. The bucket should be brought to a temperature of approximately 500 deg. F.

Water cooling should not be used on this type of weld; instead, it will be found that peening each deposited bead will be much more satisfactory. Peening should not be started until the metal cools to a black heat.

Cracks or breaks can be beveled with an oxy-acetylene cutting torch to give a single vee so that the welding can be done from one side only. The weld metal can then be applied with the bead extending the full length of the vee, or, in the case of large, heavy castings, it can be welded in short sections. If the weld metal is peened (at no more than a black heat) as the welding progresses, a little additional strength will be obtained. Bobbing or peening should be done with an air gun or a block tool similar to a caulking tool. After welding is completed, the portion of the bucket which has been preheated should be covered up, protected from drafts, and allowed to cool slowly.

Heel pad corners wear excessively in rocky formations. The following procedure for building-up worn heel pads has been found suitable. After removing the bucket from the stock and boom, the bucket should be inverted. Using two arc welding operators if possible, one working on each side of the bucket, both should begin welding just below the rounded corner. First, a bead of chromium-manganese-iron hard-facing rod about 10 in. long should be welded to the heel pad. Starting from the door edge and running toward the lip edge of the bucket, the bead should extend 1 or 2 in. beyond the limit of the heel pad. Then another bead is welded parallel and next to the first. Welding should be thus continued until a strip 4 in. wide and 10 or 12 in. long has been completed. Then, after skipping a small space about ¾ in. wide, but not more than 1 in. at the most, another 4-in. wide section, similar to the first, should be welded on. The operation should thus be repeated, with both welders working toward the center or latch plate, until the entire heel pad has been covered. Finally, the ¾-in. spaces which were left uncoated are filled in. Welding in this sectional manner will prevent blanket peeling throughout the life of the hard-facing coating.

If possible, a third man or helper should play a stream of water from a hose onto the underside of the bucket around each welding operation. The manganese body is thus kept cool and any checking or surface cracks will appear only in the deposit. Never under any consideration should this procedure be used unless running water is available. A slight variation of this is the more tedious method in which the welder frequently stops welding and pours water on the weld, but this process is far slower and does not give as good results.

The deposit need not be more than ¼ in. thick over the entire heel pad. The cost of the application is thus kept low, and the bucket is not out of service for too long a period of time. After an application has been made to a bucket and it has been placed in service, the resultant wear will show where the most abrasion occurs. The sections worn most can then be built-up heavier when the bucket is next taken out of service. Many contractors have found it profitable to hard-face new bucket fronts even before placing them in service.

Power shovel tracks, tractor treads, jaw crusher plates, and rock crusher plates may all be built-up by the same process. To prevent distortion or warpage, the piece should be constantly cooled by water.

Fig. 5—Hard-facing these drag scraper teeth and cutters saved about $60 per month.

Brief Sketches of Welding Jobs

This welded cone prevents children from stealing "rides" on the rotating eccentric.

Welder Works for Safety

★ Rotating eccentrics on central power units used to pump a number of oil wells from one power station offer a free merry-go-round ride to children of the neighborhood. Although no charge is made for a ride on one of these, frequent toll is exacted in the form of accidental injury caused by the reciprocating rods. Oil producers go to considerable expense to keep children away from this dangerous spot.

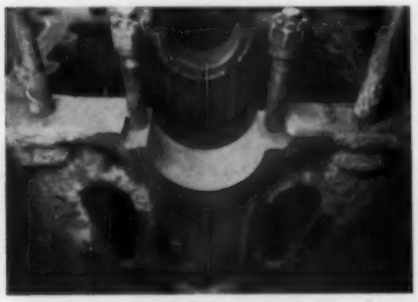
One large company enlists the aid of its welders in forming a cone of light tank plate, built up around a central stem which screws into the threaded center hole of the eccentric's main shaft. The sloping sides of this cone are steep enough to present no foothold or resting place, and thus effectively shield the otherwise attractive flat surface of the eccentric.

By making the cone so that it stands some four inches above the pins connecting the drive rods to the eccentric, lubrication of these joints is not hindered. The shield extends out far enough over these pins so that all rain is shed beyond the lubricated portion.

» «

Welder Handles a Tough Job at a Profit

★ Milton Bowers, of Milton Bowers Welding Co., Memphis, Tenn., recently had the satisfying experience of turning a welding job that looked "too tough to tackle" into a nice profit. The job was a cast-iron diesel engine base which was cracked due to a low bearing. After considerable study, he repaired the break by first studding the base, arc welding the first bead with "Ferroweld" electrode, manufactured by The Lincoln Electric Co., and then completing the weld on both sides of the frame with an electrode for mild steel. This job, which at first looked impossible, brought in $500.



Arc welded repair of cast-iron diesel engine bed.

» «

10-Ton Cast Steel Frame Repaired by Arc Welding

★ A big repair welding job was handled recently at Cisco, Texas, for the Southwest Stone Co., by Funkhouser & Grimes of Fort Worth, who operate a large job welding shop. This particular job was on the frame of a large dragline. The frame, weighing approximately 10 tons, was broken in several places.

After the machine was completely dismantled and the frame removed, the breaks were all vee'd out with a cutting torch to about a 60 deg. bevel. The depth of the frame was approximately 18 in. and it varied in thickness from 3 in. to 10 in. After each break was vee'd out, the frame was placed so that the welds would be made in a downhand position. Two welders worked on this job until it was completed. Each application of weld metal was peened with an air hammer. Type "N" Hollup Sureweld electrodes (¼ in.) were used on this job.

Two men worked steadily until the frame was repaired.

» «

Metal Spraying of Piston Rods

By H. V. KAEPPEL

★ The reclamation by metal spraying of all types of compressor, pump, and steam engine piston rods is now everyday practice in most industries. Metals to match the original metals may be applied, or if desired other alloys can be used to build-up the worn part. Typical of these are a number of piston rods from steam-operated marine pumps and other auxiliaries, which were built up 1/16 in. in diameter with low carbon steel (Fig. 1). The pieces were originally of mild steel, the diameters ranging from 1-5/16 in. to 1-9/16 in. and the worn portions were from 9 to 15 in. long.

Standard procedure for preparing these rods prior to spraying was followed. This consisted of first undercutting about 1/32 in. on a side to clean up the worn section, and then applying a rough 20 pitch V-shaped thread to a depth of 1/32 in. Sand blasting of the surface in addition to rough threading is not as a rule necessary. However, should the surface be contaminated with oil, moisture, rust, oxide, etc., the threads must be lightly blasted to produce a clean dry surface before spraying. Actual spraying time averaged 15 min. per rod using ⅛ in. diameter rod. The job was completed by finishing the rods to size in a lathe.

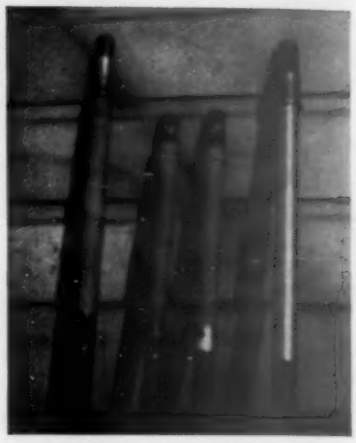


Fig. 1—These piston rods for marine pumps were built up 1/16 in. in diameter by metal spraying with low carbon steel.

Similar procedure was used for reclaiming a set of 1½ in. diameter gas compressor piston rods operating in a two-stage horizontal machine compressing carbon dioxide gas. The rods were scored and worn by the cylinder packing over a length of 24 in. and 3 lbs. of a special stainless steel were applied to each rod. It required 30 min. time per rod to rebuild to original diameter and to produce a hard and corrosion-resistant surface.

After spraying, the rods were finished to size by wet abrasive grinding as the sprayed coating was too hard to permit of machining. Several grades of stainless steel are available, however, which can be cut in the sprayed condition with ordinary high-speed tools, but the use of these materials necessarily results in the sacrifice of some hardness and wear resistance.

The cost of rebuilding these rods by metal spraying was only a fraction of the cost of replacement and, in addition, gave a surface

Fig. 2—These steel bearing pins (from dredge boat) were sprayed with 16 lbs. of stainless steel for each pin.

far superior to that of the original mild steel rods. This work was handled by the Pacific Coast Engineering Co., Oakland, Cal.

This company has also done other interesting work such as the rebuilding of steel bearing pins in the base of the digging ladder of a dredge boat (Fig. 2). These pins, 10¾ in. in diameter and 21½ in. long, were each sprayed with 16 lbs. of stainless steel giving a finished thickness of sprayed metal 1/16 in. thick over the top of the usual type of rough thread-cut. Approximately 3/64 in. on the diameter was allowed for finish grinding. This was done dry with a carborundum wheel mounted on a lathe carriage. Actual spraying time for each pin was 2½ hrs. and grinding time about four hours per pin. After grinding the surface was polished with emery.

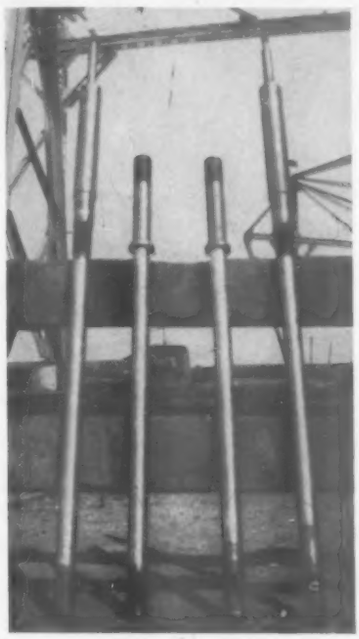


Fig. 3—Gas compressor piston rods which have been built up with stainless steel for about 24 in. of length, where rods were worn and scored by packing.

These pins are operating under salt water and previous to spraying showed considerable pitting due to corrosion, along with some abrasion due to sand and silt.

Still another job of the Pacific Coast Engineering Co. was the building up of four CO_2 gas compressor piston rods (Fig. 3). These were built up with stainless steel over a length of approximately 24 in., where the rods were worn and scored by the packing. The rods are 1½ in. in diameter. They were undercut to 1-7/16 in. and 1/32 in. deep, 20 pitch rough thread-cut applied. Approximately 3¼ lbs. of steel was sprayed on each rod. They were finish ground to 1.500-1.503 in. after spraying. Time and material cost for each rod was about $8, including preparation, spraying and grinding.

Field welding on the inside of 40-ft. Hortonsphere. Photo (General Electric).

Welded Metal Sphere to Store Hydrogen

★ The Carboloy Co. of Detroit, Mich, has installed a 33,760-cu. ft. welded sphere to store hydrogen gas for use in its furnaces in manufacturing tungsten-carbide for cutting tools. The giant metal ball is known as a Hortonsphere and permits a greater cubic content per pound of steel used than any other shape. To assemble this 40-ft. ball, the Chicago Bridge and Iron Co. used three G-E single-operated d-c. arc welding machines and G-E, W22 electrodes. All of the welding operators on this construction were qualified by the Hartford Steam Boiler Inspection and Insurance Co.

The ⅝-in. steel plates used in constructing this metal sphere were dished and cut to size at the fabricator's plant and shipped to Detroit where they were assembled. A patented key system was used in erecting the structure, the key holders being tack welded to the plates to facilitate accurate adjustment of the plate edges for welding.

» «

Welded Modernistic Eagle Uses Thin Gauge Stainless Steel

★ T. A. Beck & I. W. Beck of 577 Tenth Ave., New York City, have recently completed an ornamental eagle in stainless steel for the Landplane Administration Building, North Beach Airport, North Beach, N. Y. The construction of this bird with a wing spread of 20 ft. and a beak to tail measurement of 8 ft., entailed the use of 303 lbs. of KA-2 Rizistal 22 gauge stainless steel to cover a contour framing of 1450 lbs. of structural steel. The main body truss and wing members are fully welded with gusset plates of 4 in., 10.5 lb. channels. All contour sections are made of 1 by 1 by ⅛-in. tee bar bent and welded to the heavier members.

In sectioning the stainless plating, the designers took care to place all flat seams so as to secure a counter stress. Details such as the legs or boots, where high crowned surfaces approaching a hemisphere are secured, were first "orange-peeled," partially cold hammered and then welded and seams ground—with a final cold hammering to shape. Flat welds throughout were butted, tacked and fully welded over insulating strips of the same material which were first attached to the structural frame. Welds were ground smooth and buffed. The entire job was hand rubbed to approximate the No. 4 finish of the original stock. The carbon arc technique, using a Hobart 150-amp. Senior "multi-range" welder was used in fabrication. The job required three dozen 3/16-in. carbon pencil electrodes and 7 lbs. of 18-8, 5/64-in. coated rod to weld 140 ft. of flat seams, 170 corner seams and 75 ft. of internal angular seams.

This welded frame was covered with 22 gauge stainless sheet to create a modernistic "eagle."

New Product Developments

New low-current arc welder uses multiple-tube mercury vapor rectifier unit.

Weld-O-Tron—A New Low Current Arc Welder

★ Allis-Chalmers Mfg. Co., Milwaukee, Wis., has developed a novel design of low-current electronic arc welder for precision work. This "Weld-O-Tron" unit can be used to weld with currents as low as 5 amp., using newly developed 1/32 in. and 3/64 in. electrodes. Carbon steels, stainless steels, and other metals lighter than approximately 18 gauge, which heretofore could not be welded, without serious danger of burning the metal and destroying many of its vital properties, can now be welded readily. As a result, this new equipment is said to be applicable to many types of work previously considered too small or too light for anything except riveting, spot welding, brazing or soldering. It is stated that sheets as thin as .010 in., or approximately 32 gauge, can be handled without difficulty.

The heart of the Allis-Chalmers portable Weld-O-Tron electronic arc welder is a multiple-tube polyphase mercury vapor rectifier unit. It makes use of the newest type of rectifier tubes, specially developed for this equipment. The unit combines light weight, long life, and absence of rotating parts, combining the advaptages of both a-c. and d-c. arc welding. The readily accessible controls and terminals are of the dead-front type, and are located on the control panel. Two of them are simple two-way switches, one for current range selection, the other for reversing polarity of the tube terminals. A hand wheel, with easily readable dial, provides fine adjustment of the welding current. According to Allis-Chalmers, a constant-current characteristic has been given to the Weld-O-Tron which makes the arc easy to start, easy to hold and produces the optimum heat conditions at the weld. The same characteristics are obtained from minimum to maximum current settings, it is said.

The new Weld-O-Tron unit now being offered, and more completely described in Bulletin R-6049, was evolved to handle some of the company's own work, for which it is claimed there was no suitable equipment on the market.

"Amco" Aluminum Flux

★ A new type of flux has been developed for tinning aluminum as well as other metals, including cast-iron. Its low melting point and low price range make it a most practical flux for general work.

"Amco" aluminum flux not only dissolves the oxide on the metal to be soldered, but at the same time coats it with a metal to which ordinary tin and lead solder will adhere readily. If aluminum solder is to be used, this may be applied to the coated surface without any further preparation and a perfect bond will result, it is claimed. The flux may be used with any clean source of heat as well as with an ordinary soldering copper.

This new flux is made and sold by American Solder and Flux Co., Wayne Ave. and Berkley St., Philadelphia, Pa.

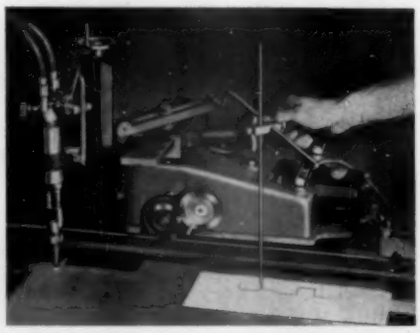
» «

Portable "Flame-Shaper"

★ The Schrader-Bowers Co., 2629 Lincoln Way West, Mishawaka, Ind., has developed a new portable flame-cutter which it is marketing under the name of "Flame-Shaper." This new unit provides stepless cutting speeds ranging from 4 to 40 in. per min., depending upon thickness of metal being cut. These speeds are obtained without varying the speed of the motor, through the use of a new compensating transmission control incorporating a centrifugal governor. The governor is in turn controlled by means of a dial which is calibrated to read in inches per minute. A machine tool type lateral carriage and a manually-operated worm gear control provide for smooth, clean cutting.

With the "Flame-Shaper" it is possible to cut straight lines and circles with either square or beveled edge, also irregular shapes. A convenient tracer guide is available to make it easy to follow drawings or templates.

With the new mechanical speed control, the "Flame-Shaper" is under the control of the operator at all times. For example, in cutting square corners the forward travel may be stopped instantly, without turning off the motor, or without disengaging the transmission gears. The lateral carriage is mounted on a supporting post in such a manner as to permit cutting at any angle. The torch holder is adjustable so that it can be placed either in front or at the sides of the machine. It is said that the "Flame-Shaper" torch will produce smooth, clean cuts in any thickness up to 8 in. A welded steel track is furnished in standard 6 ft. length, but extra lengths may be added.



The "Flame-Shaper" has a novel mechanical speed control.

» «

200-amp. Lincoln "Shield Arc Junior" arc welder.

200 Amp. Lincoln Arc Welder

★ A new 200 amp. arc welder of the Lincoln Junior type with a range for many welding applications ordinarily associated with considerably larger welding equipment, is announced by The Lincoln Electric Co., Cleveland, Ohio. This new d-c. machine will weld virtually all metals and alloys and do hard-facing work. Its speed of operation and quality of results are reported to be exceptionally high.

The new welder is a single-operator, variable-voltage type and can be used with either bare or shielded arc type electrodes. It has a current range of 60 to 250 amp. for welding duty. A special feature, now available for the first time on small arc welding machines, is Lincoln's patented dual-continuous control. This advance permits independent adjustment of voltage and current, to control arc heat and arc penetration.

Use of Class B insulation at proper points accounts for ability of the unit to withstand sustained overloads. The Class B insulation used in this welder contains no inflammable material. The coils, wound with glass-covered wire, are held in mica-lined slots separated by mica dividers, and the leads are connected into the commutator by special high-melting-point solder. End turns are insulated with mica tape. The motor is the "Linc-weld" squirrel-cage induction type for across-the-line starting. Connections are

available for either 220 or 440 volts, 3 or 2 phase; 60 cycles.

Construction is arc welded steel. Four steel feet are welded to the base and drilled for bolting in permanent position, or for attaching of 3-wheeled running gear, which is optional. The welder occupies less than 4 sq. ft. of floor space. A lifting lug facilitates crane handling.

» «

Airco Gas Cutter Has Wide Flexibility

★ The flexibility of use of the new Airco No. 10 Planograph announced by Air Reduction Sales Co., New York City, is demonstrated by its ability to flame-cut straight lines, rectangles, circles and irregular shapes from ferrous metal of any thickness within the practical limits of the cutting torch. Although a stationary-type machine, the new unit can readily be moved by a crane.

The No. 10 Planograph consists of a tracing table upon which the carriage travels. The torches and tracing devices are supported on the carriage. Operating on either 110 or 220 volt a-c. or d-c., the unit requires a minimum of floor space. Even including the work table, the new planograph requires a working area of only 5½ by 10½ ft.

Cutting range in single-torch operation is 24 in. wide by 72 in. long. This length can be increased indefinitely in multiples of 72 in. by utilizing additional tracing tables. Maximum diameter of circle cuts is 24 in. When two torches, mounted on the regular operating bar, are employed for simultaneous cutting, the cutting area for each torch is 12 in. wide by 72 in. long. Two circles each up to 12 in. diameter can also be cut with the torches mounted in this manner. By using an auxiliary bar, the cutting area of each is increased to 24x24 in.

The tracing device for manual tracing can be locked so that it will, without manual guiding, travel in a straight line in any desired direction. This time-saving feature is particularly convenient when cutting any irregular shapes which involve straight-line cutting. The devices for magnetic and templet tracing can be quickly interchanged in the existing head. The magnetic tracer, connecting directly to an electrical outlet conveniently located near the top of the tracing device head, requires 110-volt d-c. for operation.

The speed of the motor is governed by a graduated disc known as the Index Speed Control. This disc provides a complete range of motor speed in one full turn of 360 deg. The cutting speed in in. per min. is registered on the reversible tachometer.

The gas control unit on the No. 10 Planograph is centrally located. A knob handle operates cams, progressively arranged, one each for the pilot light, acetylene (or other fuel gas), oxygen preheat and cutting oxygen. One complete cycle lights and cuts off in proper sequence. Handwheels mounted on either end of this unit permit lighting or extinguishing the torch from either end of the tracing bar. For further information write to Air Reduction Sales Co., 60 East 42nd St., New York City.

» «

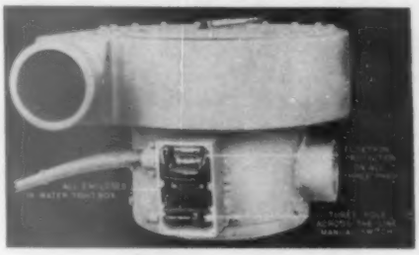
Sawyer "Master" Portable Blower

★ An innovation in blower construction is featured by the new Sawyer "Master" pressure blower designed primarily for exhausting fumes from welding operations where space is at a premium. This new unit permits exhausting through a hose rather than directly through the machine, and is capable of moving a considerably large quantity of air through hose up to 75 ft. in length.

The specially built motor is entirely enclosed and is placed in the intake air housing in such a way that the entire volume of air delivered by the blower passes completely around the motor for purpose of air cooling. Elimination of brushes, commutators, gears and centrifugal switches simplifies construction and reduces size, weight and maintenance expense, it is claimed. The Sawyer "Master" blower is furnished with one, two or four inlet ports, with inside diameters dimensioned according to capacity of the blower. Inlet ports are screened to prevent dust and dirt from affecting the impeller.

The principal advantage claimed for the Sawyer blower is its compactness. The height is 15 in. and the entire unit can be passed through an opening 21 in. in diameter. The motor is rated at 1 h.p., and operates on 220 volt, 3-phase, 60 cycle current at 3600 r.p.m. Tests show that 680 cu. ft. of air can be handled per min., with a static pressure of 3⅛ in. or higher, at 68 deg. F. Air velocity is approximately a mile a minute.

Further information can be obtained by writing to Sawyer Electrical Mfg. Co., 5715 E. Leneve Ave., Los Angeles, Calif.



Sawyer "master" pressure blower for exhausting fumes from welding shops.

» «

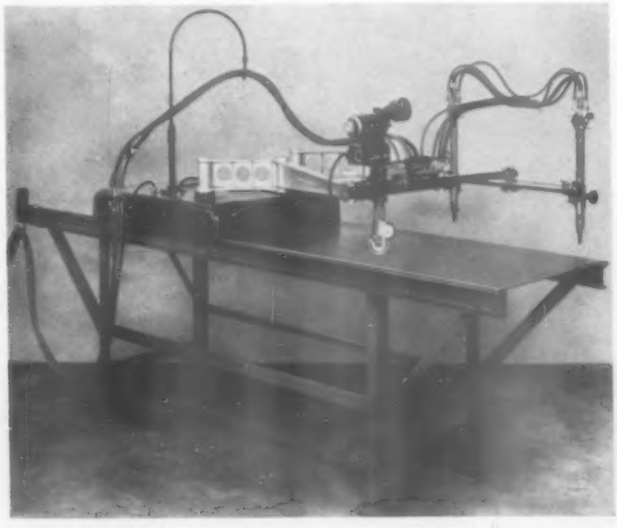
Colaweld Liquid and Rod for Joining Metals

★ A new method for joining stainless steel, low-carbon steel, as well as non-ferrous alloys is claimed to have been developed by Colonial Alloys Co., Colonial-Philadelphia building, Philadelphia, Pa. It is stated that this new process is particularly applicable to gauges from .005 to .050 in.

Colaweld liquid is brushed on the metal at the points where a bond is required. Then a special rod is applied and the assembly subjected to a temperature of about 450 deg. F. It is claimed that in a few seconds, a strong bond is completed. The thinner the gauge of metal the faster the action and the greater the strength of the connection, it is said.

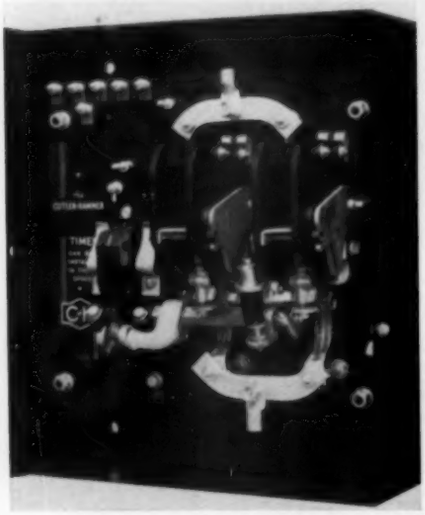
The manufacturer makes the definite claim that this process develops a welded bond and does not depend upon adhesion to hold the parts together. It is suggested that this new method will be most effective in applications which have presented welding difficulties. It is said that tensile strength at the connection is about 10,000 p.s.i.

The Colaweld method of metal joining for light gauge material accomplishes a satisfactory connection without warping or burning material. It is further claimed that it is not necessary to clean the surfaces before joining by the Colaweld process, although it is admittedly preferable to do so.



Airco No. 10 Planograph can flame-cut straight lines, rectangles, circles, and irregular shapes.

JOIN THE
AMERICAN
WELDING
SOCIETY
DO IT NOW!



Cutler-Hammer welding contactor.

Single-Pole High-Speed Contactor

★ Cutler-Hammer, Inc., 315 North 12th St., Milwaukee, Wis., has developed a new single-pole high speed welding contactor. This is the latest addition to Cutler-Hammer's line of welding control equipment. Among the important features claimed for this new contactor are: (1) Extra large drop forged contacts; (2) Adjustable contacts; (3) Large contact wear allowance; (4) Short arc gap for long life and high speed operation; (5) Powerful blowouts to extinguish arc quickly; (6) Anti-bounce cushion stop.

» «

Protect-O-Metal—A New Aid to Welding

★ Protect-O-Metal compound manufactured by G. W. Smith & Sons, 2016 East Third St., Dayton, Ohio, is a new aid in the welding and die casting industries to save money, time, and energy, by checkmating the destructive elements of friction, corrosion and adhesion, ever-present in high-heat processes. This new compound prevents corrosion and collection of spatter on the surface surrounding the weld, thus eliminating weld cleaning.

Just brush Protect-O-Metal on the surface to be welded. After welding, wipe surface with cloth or wash with water and all spatter and surface oxides are removed. Forms an ideal priming coat for a paint finish if desired. It prevents formation of rust on steel after welding and will not harm the surface. It does not produce carbon that might affect the weld or material being welded.

» «

Spot Welding Gun Mounted On Extension Handle

★ Unique combination of a light weight hydraulic spot welding gun and light weight current-carrying extension arm of aluminum has simplified the problem of spot welding in relatively inaccessible locations such as the long inside seams on a circulator heater cabinet. As shown, the entire length of each seam can be easily welded in a continuous operation. Designed and built by Progressive Welder Co., 737 Piquette Ave., Detroit, Mich., the equipment consists of an hydraulically-operated spot welding gun mounted on one end of an extension handle. Each of the two aluminum sections which comprise the handle conduct the current from the single-bolt cable connecton at the input end to a similar, single-bolt connection at the gun end. In addition to carrying the welding current, each extension handle element is of hollow section to permit supply and return of water for cooling gun and welding points. Hydraulic pressure supply to the pressure cylinder on the gun is carried in a flexible hose, along the top of the handle. Push-button control at the operator's end of the unit is in the form of a handle for easy manipulation.

In production, the heater cabinet shown, is stamped and formed in vertical sections. The sections are then placed in a jig so designed that each inside seam to be welded, can, in turn, be vertically located. The operator places the welding points of the gun in position and begins making the welds at 1½-in. centers, sliding the gun down the entire length of the seam in a continuous operation. To permit close control of spot locations and to provide easier operation of unit for the section of seam beyond the middle, a wheel, mounted on under side of extension handle provides necessary balance. Production speed is about 40 cabinets per hour.

(Upper) Welding gun mounted on current-carrying extension handle is placed in welding position for continuous spot welding of inside seam. (Lower) Trolley wheel, riding on edges of seam, facilitates control and locating of welding gun.

News of the Industry

A.S.M.E. to Meet December 4-8—Dedicated to the peaceful purpose of "broadening the usefulness of the mechanical-engineering profession," the 60th annual meeting of The American Society of Mechanical Engineers, to be held in Philadelphia, Pa., at The Bellevue-Stratford hotel, December 4-8, 1939, is the first annual meeting of the Society to be conducted outside of New York City since 1890, and the first national meeting in Philadelphia since 1887. A general committee, composed of Philadelphians and headed by Nevin E. Funk, vice-president of the Philadelphia Electric Co., is completing final plans for the meeting, including technical sessions, social functions, business meetings, inspection trips, college reunions, and a photographic exhibit.

Personals

International Nickel Co. Executive Changes

James L. Ashley, secretary and treasurer of The International Nickel Co. of Canada, Ltd., who has been an executive since the formation of the International Nickel Co. in 1902, has elected to retire from these posi-

(Continued on page 48)

Colonel Roscoe Turner, famous air race pilot watches with interest a demonstration of a new oxy-acetylene welding torch at the National Metal Exposition. Photo (Bastian-Blessing Co.).

ANACONDA 997

a tough weld metal with low fuming characteristics

This steel gear broke down six different times over a period of three years. All repair welds were made with Anaconda 997 Low Fuming Rods, and *each succeeding fracture occurred outside of any previously welded area* — interesting evidence of the dependability of welds made with this tough Anaconda Rod.

IN the general oxy-acetylene repair welding of equipment made of copper alloys, nickel alloys, steel, cast iron and malleable cast iron, Anaconda 997 Low Fuming Welding Rods provide tough, high strength welds. When correctly used, they give off a minimum of fumes. This rod is manufactured under U. S. patents RE-17631 and 1525058.

Sixteen other Anaconda Copper Alloy Welding Rods are available for general and specific welding purposes. They can be obtained from welding supply houses everywhere.

Anaconda Publication B-13, a twenty-eight page descriptive and informative manual covering the whole list of Anaconda welding rods, should be in your files. Write for a copy, today. 39131

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • *Subsidiary of Anaconda Copper Mining Company*

tions under the company's retirement system. While Mr. Ashley retires as an officer of the company, he will continue to serve in an advisory capacity for several months.

WILLIAM J. HUTCHINSON, who served as a director for approximately 10 years and a member of the executive committee of the present Canadian company since 1928 was elected to succeed Mr. Ashley as treasurer. He was also elected a director. HENRY S. WINGATE, assistant to the president of the International Nickel Co., Inc., was elected secretary to the parent company.

» «

J. C. JOUBLANC has been appointed chief metallurgist for R. G. LeTourneau, Inc., Peoria, Ill. His duties will include metallurgical control and supervision as well as research and development of new techniques. Mr. Joublanc was formerly chief metallurgist of Harnischfeger Corp., Milwaukee, Wis., but resigned on October 31, 1939, to join the LeTourneau organization.

Mr. Joublanc is a graduate chemical engineer who began his metallurgical career with the United Alloy Steel Corp., Canton, Ohio, now part of the Republic Steel organization. After 10 years with United Alloy Steel, Mr. Joublanc went with Lincoln Electric Co. to engage in welding research and development. Four years later he left the Lincoln Co. to go with Harnischfeger as chief metallurgist and technical director of the Electrode Division.

» «

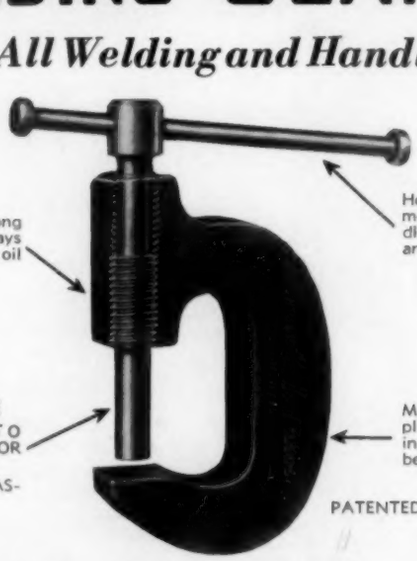
W. M. HAYES, Detroit district manager of the Air Reduction Sales Co. for the past 13 years has resigned to join the sales organization of P. R. Mallory & Co., Inc., effective November 1.

Mr. Hayes is known in the automotive and metal working industries through his activities in technical organizations as well as in Detroit civic groups. He is a charter member of the Engineering Society of Detroit and has served on its affiliate council and various committees. He is also a member of the Society of Automotive Engineers and the American Welding Society, serving as an officer of the latter group for several years. Mr. Hayes will concentrate his activities in the central west, and work directly from the plant at Indianapolis, Ind.

"Red Head"

WELDING CLAMPS

Withstands All Welding and Handling Abuses


Heat treated for long wear. Threads always protected. Retains oil for long period.
Heat treated chrome molybdenum alloy handle offers great resistance to bending.
MAIN FEATURE
NO THREADS TO DAMAGE IN OPEN OR CLOSED POSITION.
WELD SPATTER EASILY REMOVED.
Made from solid steel plate, heat treated, giving great resistance to bending or twisting.
PATENTED

14 STOCK SIZES

Special Sizes and Shapes Furnished for Special Applications

INDESTRUCTIBLE CONCEALED THREADS

Red Head Welding Clamps have been especially designed for welding service. Their construction eliminates the trouble caused by weld spatter or accidental damage to threads. A clamp that will stand up under the most rigorous service over long periods of time.

A trial will convince you. Send for sizes and prices today.

TERRITORIES OPEN FOR JOBBERS

CHICAGO BOILER COMPANY

1965 Clybourn Avenue — Chicago, Illinois

a.W.S. Activities

PITTSBURGH SECTION, A.W.S.—GEORGE F. WOLFE, chairman of the Pittsburgh Section, and also chairman of the Welding Committee at Dravo Corp., spoke on the subject "Modernization of a Structural Shop for Welding," at the last meeting held November 15 at Mellon Institute of Industrial Research in Pittsburgh. He described changes made in relocation of equipment in his company's shop at Neville Island and also covered the rebuilding of old equipment to adapt it to welding production.

"Welded Cranes and Hoists" was the subject of a paper by C. PERRY STREITHOF, structural engineer of Dravo Corp., which was presented at the same meeting. He covered construction of all-welded gantry cranes and referred specifically to two recent cranes built for an eastern shipyard. Both of these technical papers were illustrated with slides.

» «

LOS ANGELES SECTION, A.W.S.—A very complete program was featured at the November 16 meeting held at the Hayward Hotel at 6th and Spring Sts. HAROLD WICKSTROM, consulting engineer, spoke on "Liquified Petroleum Gases in Industry"; ROY HANSON talked on "The Manufacture of Butane Tanks and Equipment" and W. J. CHAFFEE, territorial manager for Hobart Brothers Co., described a housing development known as "Edgehill" which was made possible by arc welding.

» «

NEW YORK SECTION, A.W.S.—A joint technical meeting was held with the Metropolitan Section of A.S.M.E. on November 15 at the Engineering Societies Building, 33 West 39th St. J. T. PHILLIPS, superintendent of boiler shop for Foster-Wheeler Corp., presented a paper on the welding of pressure vessels. In this he discussed the effect of design on welding and presented several shop views of work in progress. His talk also included a discussion of distortion caused by welding and the effect on physical

properties of weld metal as deposited by different welding procedures.

At the same meeting, J. F. BECHTLE, welding engineer for M. W. Kellogg Co., talked on "Fabrication of Large Diameter Pressure Vessels." His talk covered some of the vital points which have to be considered in building large diameter vessels and not normally encountered with the smaller diameter pressure vessels.

» «

MILWAUKEE SECTION, A.W.S. — "Flame Heating and Hardening" was the subject of a paper by STEPHEN SMITH, development engineer of Air Reduction Sales Co., at the October 20 meeting held at the City Club, 756 N. Milwaukee St. His talk was illustrated by motion pictures and slides. He also displayed a number of samples of flame hardened pieces. Before the technical meeting, CARL H. FRANKE of the Eastman Kodak Co. gave an interesting talk on color photography.

» «

DETROIT SECTION, A.W.S.—At the meeting held November 3 in the Colonial room of the Detroit-Leland hotel, the Section was addressed by H. C. HETTELSATER, of Harnischfeger Corp., on the subject "Designing Construction Machinery for Production by Welding." Through courtesy of A. O. Smith Corp., of Milwaukee, Wis., a motion picture was shown depicting flash welding operations in slow motion.

» «

LOS ANGELES, A.W.S.—At the meeting of October 19, held in the Mary-Louise Tea Room, 818 West 7th St., an open forum was conducted for the benefit of members. This is an annual event with the Los Angeles Section and permits welders to ask any troublesome questions and get them answered with the help of more experienced men, who are glad to contribute from their fund of technical knowledge.

Trade News

MOSSMAN YARNELLE CO., 230 Pearl St., Fort Wayne, Ind., has been appointed welder and electrode agent for the Harnischfeger Corp. of Milwaukee, Wis. The new agent will operate on an "open" basis under the supervision of the Chicago office.

Example of heavy plate welded fabrication for 10-ton crusher base.

BANKS-MILLER SUPPLY CO., Huntington, W. Va., has been appointed a Hollup distributor in the Huntington territory and will carry a complete line of Sureweld electrodes and Wanamaker coated and processed electrodes. This distributor will have at his service the factory-trained welding engineers of Hollup Corp. Banks-Miller Supply Co. is also a distributor of mining, mill, electrical supply and contractors' equipment.

» «

NINE MONTH'S SALES UP 13% — Sales billed by GENERAL ELECTRIC CO. during the first 9 months of 1939 amounted to $217,900,154, compared with $192,501,173 during the corresponding period of 1938, an increase of 13%. Profit available for dividends for the first 9 months this year amounted to $25,022,631, compared with $17,548,256 for the first 9 months last year, an increase of 43%. Orders received during the 9 months ended September 30 amounted to $248,581,851, compared with $188,756,958 for the corresponding period in 1938, an increase of 32%.

» «

UNITED STATES STEEL PRODUCTS CO., a United States Steel Corp. export subsidiary, has changed its name to United States Steel Export Co., effective November 1.

By substituting the word "export" for the word "products" it is felt that the company name will indicate more clearly the type of business carried on. The export subsidiary of United States Steel does not manufacture any steel products, but is the sole export outlet for the diversified line of

Features which assure SUPERIOR WELDING QUALITIES of

Use of Purest Raw Materials Obtainable, such as Electrolytic Copper 99.96 in purity and Electrolytic Zinc 99.99 plus.

Strict Laboratory Control; Uniformity of Mixtures and Casting Temperature.

Double-Deoxidation Process which eliminates injurious gases.

PENN BRONZE—a general-purpose rod, melting at 1620° F. Tins readily and uniformly on galvanized, malleable or wrought iron, as well as steel, brass, bronze and any other non-leaded metal with melting point above 1850° F.

TITAN MANGANESE BRONZE—especially adapted to production of tough, hard deposit. Particularly recommended for cast-iron repairs, where extremely dense, non-porous weld is essential.

Submit your particular bronze-welding problem for solution by our engineers. Recommendations gladly forwarded, together with generous sample for trial in your own plant.

Titan Metal Manufacturing Co.
Bellefonte, Pennsylvania

products manufactured by the subsidiaries of United States Steel Corp. The United States Steel Export Co.'s main office is located at 30 Church St., New York City.

Recent Patents

Welding Machine

2,173,368. William H. Martin, Pleasant Ridge, Mich. Filed Nov. 15, 1937. Issued Sept. 19, 1939. A resistance welding apparatus is described which has a plurality of welding elements supported on a suitable frame. Fluid pressure means are employed for moving the welders to and from the work. An electric control device, operated by the pressure means, automatically produces alternate high pressures and intermediate low pressures to produce the operation of the welders sequentially during the high-pressure periods.

» «

Flux Composition

2,174,551. Lionel Cinamon and Samuel Sklarew, New York, N. Y., assigned to Special Chemicals Corp., New York. Filed Dec. 30, 1936. Issued Oct. 3, 1939. It is pointed out in this patent that an ideal fluxing agent is one which performs the triple function of: covering the brightened metal surfaces to exclude air; acting as a solvent for the metal oxides formed by the action of the air; and acting as a detergent or coagulant, to cleanse and float away from the metal surfaces the oxides and other foreign matter present. The flux of this patent not only has these characteristics, but also has a minimum toxis effect on the mucous membranes of the respiratory and ocular portions of a worker's body. Essentially the flux composition includes an alkali boro-fluoride and an alkali silico-fluoride as the active ingredients. For welding certain metals, such as stainless steel, nickel, and Monel metal, it is necessary to etch the metals prior to welding. For this reason, a small amount of potassium acid fluoride is added to the flux. A minimum of the acid fluoride is employed, since it is definitely toxic and injurious to the respiratory and ocular mucous membranes. The flux is particularly adapted to the welding of stainless steel, steel, iron, copper, brass, bronze, platinum, gold, silver, Monel metal, nickel, and German silver. Upon cooling from the welding temperature, the flux forms a continuous glass-like film over the metal surface; the surface, upon removal of the film, is bright and shiny. Moreover, the flux is easily reduced to a paste with water; applies to metal in a satisfactory manner; maintains a low surface tension during welding; and uniformly coats the metal. A preferred composition is given by the patentee as being a combination of boric acid; alkali fluoride; alkali silico-fluoride; and alkali boro-fluoride; the concentration of the boric acid content of the composition predominating over each of the other ingredients; and the boro-fluoride content exceeding the silco-fluoride content.

» «

Welding Thin Wires

2,174,628. Hans Gerull, Vienna, Germany. Filed March 1, 1938. Issued Oct. 3, 1939. This patent relates to a method of butt welding thin wires which consists in bringing the wires into aligned and contacting relation, preheating the joint only of the wires below welding temperature in a non-oxidizing flame completely surrounding and protecting the joint from air oxidizing effects, and then temporarily adding a combining and temperature increasing gas to the flame to raise the temperature of the joint to welding heat at the instant at which welding is to be effected.

» «

Electric Welder Control

2,174,928. Ernest Riemenschneider, Lakewood, and Arnim W. Luedtke, Cleveland, Ohio, assigned to The Midland Steel Products Co., Cleveland. To maintain a welding current substantially constant throughout the welding operation, means are provided for progressively inserting a magnetizable metal in the field of the welding circuit to compensate for the metal being welded as the latter moves out of the field of the welding circuit. By this procedure the same amount of metal is kept in the field of the welding circuit throughout the welding op-

REGISTERED U.S. MANGANAL PATENT OFFICE

NEW! TITE-KOTE WELDING ELECTRODE
for A. C. Welding

This newly-introduced electrode for A.C. welding is identical with the regular bare MANGANAL electrode, except that it possesses a *SPECIAL SELF-PEELING COATING that in no way retards the quick cooling of the weld deposit.*

Welds made with this new electrode possess the same ductility and toughness possessed by deposits made with MANGANAL bare electrodes.

Available in 1/4, 3/16, 5/32 and 1/8 in. sizes (14 in. length). Packed in 50-lb. containers.

Write for name of nearest Manganal distributor

STULZ-SICKLES CO. Sole Producers 91 N. J. Railroad Avenue, NEWARK, N. J.

Manufacturers of MANGANAL Manganese Nickel Steel WEDGE and APPLICATOR BARS, Hot Rolled PLATES, etc.

The Improved "Round File" Gas Lighter

Most Economical

Unrivalled economy is provided by the many superior, exclusive design and construction features of the Improved "Round File" lighter.

An unusually large file area is provided — **approximately one square inch.** The file is of superior quality, hardened in our own factory. The spark metal is of large diameter and the patented cartridge holding the metal locks exactly into position, **permitting instant replacement.** The lighters are cadmium plated, rustproof.

Circulars and prices on request

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

eration. The machine described in the patent is especially suited for welding spiral fins, such as heat radiating fins for absorption types of mechanical refrigerators. In such welding, the inventor employs a transformer having a pair of horns connected to the secondary and defining a work space between the horns. A pair of roller electrodes are mounted on the ends of the horns, one roller electrode engaging the inside of the cylinder on which a spiral fin is to be welded, and the other engaging the channel of the fin to rotate the cylinder. There are located a pair of guide rolls mounted at opposite sides of the fin engaging electrode, to contact opposite sides of the fin and to cause the cylinder to be progressively moved longitudinally and out of the space between the horns as the cylinder is rotated.

» «

ELECTRODE HOLDER

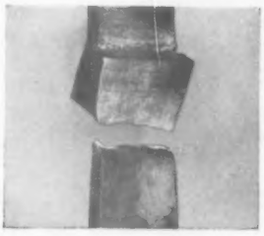
2,174,809. DANA P. VARNER, Melvindale, Mich. Filed April 14, 1937. Issued Oct. 3, 1939. An electrode holder is shown comprising a tubular handle formed from insulating material and having a plurality of openings or perforations to facilitate the air venting of the handle to cool it while in use. Suitable jaw and rocker members are mounted on the handle to accommodate the electrode.

» «

FUSION WELDING

2,175,026. LEONARD JONES, Davyhulme, England, assigned to General Electric Co., New York. Filed June 13, 1938. Issued Oct. 3, 1939. When fusion welding butt or edge joints, it is the practice to maintain the amount of heat available in the welding zone as constant as possible along the whole length of the joint so that the fusion of the metal parts at the joint will be uniform along the whole length of the joint. This is usually effected in atomic hydrogen welding by maintaining the arc voltage constant assuming, of course, uniform speed of travel and spacing of the welding electrodes along and from the joints as well as uniform arc current and uniform flow of gas to the arc region. However, when the available heat in the welding region remains unchanged throughout the whole length of the joint, there is a tendency for the molten metal of the point, possibly due to surface tension, to leave the finishing end of the joint and flow back toward the middle of the joint, thus leaving a groove at the finishing end.

The invention eliminates this groove by providing a method of welding in which a substantially constant amount of heat is supplied along the length of the joint, until the weld approaches the end of the joint when the heat is reduced sufficiently to complete the weld without having the molten metal at the end of the joint flow back toward the middle of the joint. The method applies not only to atomic hydrogen welding, but also to other fusion welding methods. The patent covers the apparatus as well as the method of welding. In the apparatus elements are provided for maintaining a substantially constant predetermined spacing between the arcing terminals of the electrodes until they approach the end of the seam, when the spacing between the terminals is reduced during the final portion of their travel along the seam.



STRENGTH

SIL-FOS and EASY-FLO brazed joints are stronger than the metals joined. Under breaking tests the metals joined give way—not the joints.

DUCTILITY

Bend, twist, hammer and pound SIL-FOS or EASY-FLO joints—the silver in them makes ductile joints that are practically indestructible.

IT'S THE COMBINATION of low brazing temperatures, free-flowing action and diffusion into metal surfaces that makes SIL-FOS and EASY-FLO joints so strong and tough.

SIL-FOS, flowing at 1300° F, and EASY-FLO at 1175° F, penetrate instantly to every part of a joint and "dig in" to make bonds as strong as the metals themselves.

It's the *silver* in SIL-FOS and EASY-FLO that gives them their free-flowing qualities and ability to penetrate and bond so thoroughly.

The *low working temperatures* add to their brazing speed and economy by savings in time and gases—and they also guard against damage to physical properties.

SIL-FOS and EASY-FLO are improving quality and cutting costs for manufacturers all over the country. If you join metals—ferrous or non-ferrous—find out what they will do for you. Write—today—for BULLETINS W5, 9 and 10.

HANDY AND HARMAN

HANDY & HARMAN FOUNDED 1867 QUALITY SERVICE

82 Fulton St., New York, N. Y.

Agents in Principal Cities

In Canada: HANDY & HARMAN of Canada, Ltd., Toronto

Trade Literature

BULLETIN ON SAFETY GOGGLES—An attractive two-color news bulletin which explains all recent improvements in Ful-Vue safety goggles has been published by American Optical Co., Southbridge, Mass. Copies will be mailed to readers on request. Features referred to are the goggle's new double-braced bridge of adequate structural strength to assure longer service; the three eye sizes and three bridge sizes that permit more exact fitting to workers; the special sizes of Ful-Vue goggles designed to fit every type of face; and the transportation goggle, especially developed to protect railroad men, truck and bus drivers against wind, dust, cinders, flying particles, and glare.

The bulletin also points out that all Ful-Vue goggles may be fitted with 6-curve clear Armorplate lenses accurately ground to the worker's own prescription for corrective glasses. The goggles may also be obtained with Super-Armorplate Calobar lenses. These Calobar lenses are scientifically compounded to cut down the dangerous ultra-violet and infra-red rays. At the same time they reduce glare and give clear, accurate, and comfortable vision. Both clear and Calobar Super-Armorplate lenses were developed to resist impact of rivets, chips, and other flying particles.

101 WELDING IDEAS FOR LOW-COST MAINTENANCE

This new bulletin which illustrates and describes a wide variety of money-saving repair, fabrication and structural applications of arc welding, has been published by The Lincoln Electric Co., Cleveland, Ohio.

The new bulletin presents brief case studies of 101 actual maintenance jobs, showing just how general repair work of broken and worn parts—both structural and mechanical—also fabrication of replacements, piping, jigs, fixtures, etc., is done by the arc process.

Included among the many case studies are repair jobs in pulp and paper mills, power plants, mines, construction projects, railroad shops, metal-working plants, rock products plants, dredging operations, meat-packing plants, truck and bus maintenance departments, gas plants, oil fields, steel plants, shipyards, pipelines, garages and repair shops, rubber plants, etc. Descriptions give procedure data, sizes of materials, as well as savings in weight, time and cost. Copies of the new bulletin may be obtained free upon request to The Lincoln Electric Co.

» «

FACE SHIELD CATALOG—Face shields is the subject of a new 4-page catalog issued by the Boyer-Campbell Co., 6540 Antoine St., Detroit, Mich. This catalog features 7 models and 15 different numbers, describing in detail the right face shield for the job. Due to interchangeability of parts some models may be adjusted to suit almost every industrial need.

COMPOSITE DIE SECTIONS—Jessop Steel Co., 627 Green St., Washington, Pa., has issued a new wall chart which gives specifications for Jessop rolled composite die sections, used in dies for cutting sheet metal to regular or irregular shapes. End views of eight different die sections are illustrated.

Among advantages of rolled composite die sections are ease of machining and forming, welding, and possibility of drilling dowel and screw holes after hardening.

» «

A.W.S. AND A.S.T.M. SPECIFICATIONS FOR WELDING ELECTRODES

The tentative specifications for iron and steel arc-welding electrodes approved by both the American Welding Society and the American Society for Testing Materials, are offered, along with other educational material, in a 24-page catalog issued by The McKay Co. Advice as to proper discrimination among different mild-steel electrodes, according to the nature and conditions of work, is given in charts and comparisons are offered that should be helpful to a user of either McKay shielded-arc welding electrodes or of some other brand. The new catalog (E-16) may be had by writing to the general sales offices of The McKay Co. at York, Pa.

» «

REGO WELDING AND CUTTING EQUIPMENT—A 36-page, easy-to-use, pocket size catalog, describing complete line of Rego welding and cutting equipment is now available. This catalog not only describes up-to-the-

Model A-2, above, 300 Amps. Replaceable jaws take rods from 1/16" to 1/4". Also available in 500 Amps. (A-3) and in Model A-1, same as A-2 but without replaceable jaws.

IN CANADA:
Hollup Corporation Ltd., Toronto, Ont.
Paragon Supplies, Ltd., Vancouver, B. C.

EXPORT MANAGERS:
International Technique, 381 Fourth Ave.
New York City

JACKSON
Top-flight Holders

Completely insulated for the welder's safety and to reduce work spoilage. Well ventilated—they work cool. If you're looking for "the best" holder, try a Jackson. You'll never give it up.

JACKSON ELECTRODE HOLDER CO.
15122 Mack Avenue Detroit, Michigan

minute equipment, but also contains recommended tip sizes for welding various metal thicknesses, complete data on tip sizes and gas pressures for cutting iron and steel from 1/16 to 18 in. thick.

New items listed for the first time are: (1) Rego KX cutting torches with stainless steel head and tubes. (2) Rego GXH multi-flame tips for hard surfacing and general heating. (3) LGX and XGX extra length welding torch handles for special applications (10¾ in. and 14 in. long respectively).

A copy of this catalog can be obtained by writing to The Bastian-Blessing Co., 242 E. Ontario St., Chicago, Ill.

Classified Section

ADVERTISING RATES

Help Wanted — 75c per line, minimum 4 lines. Jobs Wanted — 4 lines free. Other Ads — $1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

BARGAINS—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Hobart Welder Exchange, Box U-1191, Troy, Ohio.

FOR SALE—Acetylene Welding Equipment, $35.95 to $73.75. Easy Payment Plan. Superior Oxy-Acetylene Machine Co., Hamilton, Ohio.

FLY-BALL GOVERNORS—Adapted to all makes of auto engines; belt driven, flat or V. Price $6.50 prepaid; ball bearing, $2.00 additional. Satisfaction guaranteed. In ordering state style of belt. Wm. Alber, Beatrice, Nebr.

FOR SALE—Metallizer Gun $100. Pierce Governor $17.50. 100 Amp. Engine Welder $150. Mill-ends, like new, super rubber-covered welding cable No. 2 at 18c; No. 1 at 20c; No. 1/0 at 26c; No. 2/0 at 30c. Address N-4, The Welding Engineer.

POSITION WANTED

WELDING ENGINEER WITH SALES EXPERIENCE—10 yrs. exp. with oxy-acetylene, metallic and shielded arc welding. Will demonstrate ability to meet an executive, and sell his engineers and welders, particularly on carload contracts. Experienced in ship, tank, pipe-line and boiler welding. Can pass all code tests. Acquainted with large users of shielded arc electrodes. Experienced teacher. Desires to contact either electrode or equipment manufacturers. Address N-2, The Welding Engineer.

INSPECTOR, SUPERVISOR AND INSTRUCTOR OF WELDING—8 yrs. exp. Knowledge of heat treating and physical metallurgy. Capable of performing all tests and investigations of weld metal. Has had sales exp. Also exp. machinist. Address N-3, The Welding Engineer.

COMBINATION WELDER, SALESMAN OR MILLWRIGHT—10 yrs. exp. as welder and 10 yrs. sales experience. Willing to go anywhere. Address N-1, The Welding Engineer.

GAS AND ARC WELDER—10 yrs. exp. in all fields. Boilermaker, layout man, good references. Robert L. Stein, Box 56, Pondosa, Oregon.

Statement of the Ownership, Management, Circulation, Etc., Required by the Acts of Congress of August 24, 1912, and March 3, 1933

Of THE WELDING ENGINEER, published monthly at 506 So. Wabash Avenue, Chicago, Illinois, for October 1, 1939.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared G. H. Mackenzie, who, having been duly sworn according to law, deposes and says that she is the Publisher of THE WELDING ENGINEER and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, G. H. Mackenzie, 506 So. Wabash Avenue; Editor, R. S. Kenrick, 506 So. Wabash Avenue; Managing Editor, None; Business Manager, E. W. Stewart, 506 So. Wabash Avenue.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) The Welding Engineer Publishing Co., 506 So. Wabash Ave., Chicago, Illinois; G. H. Mackenzie, 506 So. Wabash Ave., Chicago, Illinois; T. E. Depew, 1834 Broadway, New York, N. Y.; H. S. Card, 449 Elmora Ave., Elizabeth, N. J.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by her.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is..... (This information is required from daily publications only.)

G. H. Mackenzie, Publisher.

Sworn to and subscribed before me this 26th day of September, 1939.

[Seal] (Signed) Flora Kline, Notary Public.

(My commission expires March 14, 1940.)

THOUSANDS OF WELDING SHOPS
ARE MAKING ADDITIONAL PROFITS IN THIS NEW FIELD

Is your shop? Prepare your shop during the winter months for more profits next year.

U. S. Patents 2,013,818 and 2,051,234
Canadian Patents 365,296 and 369,723

ELECTRIC WELDED
Write for new catalog now
WIESE PLOW WELDING COMPANY, PERRY, IOWA
Originally New Process Plow Welding Co.

TWECO PRODUCTS

BETTER CABLE CONNECTIONS FOR ELECTRIC WELDING
REDHEAD AND PERFECTION
GROUND CLAMPS
TWECO ELECTRODE HOLDERS
MECHANICAL CABLE LUGS
CABLE CONNECTORS
TWECO PRODUCTS CO.
WICHITA KANSAS

NEW CUTTING TORCHES—New #30, Button Type; New #301, Lever Type.

FLASH
#30 Torch $20.00
#301 Torch $22.00
Both with 1 Tip

PRICED TO SELL—COMPLETE OUTFITS
Full line of equipment at a price. For literature and information
Gasweld Equipment Co., 625 W. Jackson Blvd., Chicago, Ill.

WELDERS Your Engine Driven Welder will provide correct heat at the arc if the motor is equipped with a sensitive PIERCE GOVERNOR.
ASK YOUR WHOLESALER
THE PIERCE GOVERNOR CO., Anderson, Indiana, U. S. A.

THIS LITTLE GIRL WILL HAVE A HAPPY CHRISTMAS *but*

Tuberculosis is still the greatest killer of youth . . . and takes *fifty per cent more girls* than boys between the ages of 15 and 25!

Two modern aids that help the physician detect tuberculosis in its earliest, *curable* stage are the tuberculin test and the chest X-ray.

Your purchases of Christmas Seals make it possible, not only to teach people that tuberculosis is preventable and curable, but to look for early stages of this dread disease among children who *seem to be* in good health.

So from now 'til Christmas, mail no letter—send no package—unless it is decorated with the Christmas symbol that saves lives!

The National, State and Local Tuberculosis Associations in the United States

BUY CHRISTMAS SEALS